NATIONAL INDUSTRIAL CONFERENCE BOARD, INC.

INDUSTRIAL STANDARDIZATION

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PREFACE

THE principle of standardization, as it is expressed in the products, processes and practices of industry and trade, is now generally recognized as a fundamental characteristic of our modern economic system. Although standardization is an old and universal idea, reflected in many aspects of social life in all periods of human history, its intensive application in the modern machine industries is a distinctive feature of the economic development of the past generation. The rapid industrial growth of the last two decades, particularly in the United States, may be said to be based largely upon the partly unconscious, partly deliberate, extension and refinement of industrial standardization; and the influence of this process is felt today in every aspect of American business life.

So pervasive is the application of the principle that, except for a few groups especially concerned with it, we have come to take it for granted and have failed to appreciate its significance, the extent and manner by which it is being systematically advanced, its relation to industry, to government and to the public, and the problems to which it has given rise. Despite the constant discussion of certain of its aspects and the mass of literature bearing upon its technical phases, it is singular that there is so little general or popular understanding of the industrial standardization movement and that there has not so far been available in any single volume a clear and comprehensive exposition of the movement as a whole. It is the purpose of the present study to supply this need.

In addition to presenting a simple and clear statement of the nature and meaning of standardization, this volume has a two-fold object: first, to present a concise but comprehensive description of the working structure of the industrial standardization movement as it is expressed in the standardization work of individual concerns, engineering societies,

trade associations and national and international standards organizations; and, second, to examine, in the light of available evidence, the authenticity of the numerous economic advantages claimed for standardization by its advocates, and to discuss some of the economic and social problems involved in the progressive extension of the standardization principle.

As regards the first of these objectives, the study reveals the phenomenal growth, in all the great industrial countries, particularly during and since the war, of a technique of standardization which plays a basic and necessary part in machine industry. There has been much confusion, overlapping of functions, working to cross purposes, conflicts of interests, and misunderstandings; but, at the same time, there has been gradually evolving from this chaos a co-operative method of handling problems of industrial organization and processes, which has great significance for the student of politics as well as the economist.

The second task has been more difficult. Tangible facts regarding the achievements and economies of standardization are few and far between. A considerable part of the available data had to be set aside as of dubious authenticity or as irrelevant. There are questions regarding the effects of standardization which can not be answered, even tentatively, by an appeal to evidence, and in many such cases the discussion has necessarily consisted of a statement of the questions that will need to be answered before an evaluation of economic advantages and disadvantages can be made. Yet, despite these difficulties, the cumulative evidence points unmistakably to the conclusion that industrial standardization is one of the significant and far-reaching methods for increasing industrial efficiency, to the benefit, if properly used, of all interests concerned. It is clear, too, that the achievements in the past are but guide-posts to possibilities in the future.

Special acknowledgments for aid in the preparation of this volume are due to the officers and staff of the American Standards Association and to several corporations, particularly the Bell Telephone System, the Westinghouse Electric and Manufacturing Company and the Detroit Edison Com-

pany, which supplied the Conference Board with valuable material concerning their own standards work.

In the preparation of its studies the National Industrial Conference Board avails itself of the experience and judgment of the business executives who compose its membership, and of recognized authorities in special fields, in addition to the scientific knowledge and equipment of its Research Staff. The publications of the Board thus finally represent the result of scientific investigation and broad business experience, and the conclusions expressed therein are those of the Conference Board as a whole.

The present investigation was made, and this volume was prepared, under the supervision of the Conference Board's Staff Economic Council, by Mr. Robert A. Brady of the Conference Board's Research Staff.

MAGNUS W. ALEXANDER,
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New York City

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Part I

CHAPTER I

HISTORICAL SETTING FOR THE STANDARDIZATION MOVEMENT

STANDARDS are of the nature of habit. And habit is an outstanding characteristic of all human action. Whether man ever lived singly and in isolation we do not know. That he ever lived without habits seems highly improbable. But we do know that wherever we find people living in groups, whatever be the group basis upon which they live, we find habitual, set, and highly routinized behavior. The more complex the group organization becomes, the more significant routinized behavior becomes. Wherever group action is called for, concert demands systematic, specialized and highly organized activity.

This fact is, perhaps, best illustrated by war-like activity. The development of the arts of war very early necessitated specialization of function and standardization of the work of separate units, such as infantry, cavalry, archery, and later, artillery, ordnance, hospital, commissariat, etc. These units in turn necessitated a set of formally routinized procedures, called tactics, for given strategic situations in coping with the enemy. Tactics were impossible without that concerted action that brought into being the fixed hierarchy of command and subordination that is so conspicuous a feature of military organization. In modern times the whole rounded-out structure for the prosecution of war is fitly called a "war-machine." It is an elaborately articulated, meticulously detailed, and carefully intermembered machine, in which every duty, attitude and operation is routinized in great detail.

Other forms of human activity have, from the earliest known times, exhibited the same general characteristics.

All societies have shown at some stage or other, if not at all stages of their development, definite social classes, at times hardened through long habituation to fixed and unchangeable castes. The researches of the anthropologists have found class lines, within which there are definite, fixed social rules and regulations governing practically the whole realm of the life-activity of the group, to be a marked characteristic of all of the so-called "primitive peoples."

Religions afford another interesting example of standardized, routinized human activity. Mohammedanism, Buddhism, Zoroastrianism, Christianity, with all their sects, heresies and schisms, are standardized to the most minute detail, with regard to the time, place, form or conditions of worship, and the doctrines, ritual, beliefs, hopes and expectations of the worshippers. The religious devotee worships according to his faith a given deity or principle, in a given fashion, with a given set of incantations of a symbolic nature, at a given time, in a given place, garbed in clothes of a prescribed sort, and expects to receive in return certain definite, standardized results, predictable beforehand and following the accepted procedure of the church.

While it has been customary, especially in contemporary times, to regard standardization and style as antithetical terms, from many points of view the reverse is true. Style is of a piece with custom, social convention, ritual and taboo. It grows out of the mores of the group and is backed by the forces of public approval and disapproval. Punitive measures are visited upon transgressors, whether the style has to do with clothing, methods and ways of eating, sleeping, worshiping or conducting marital life. The style is standard for the time. It must be obeyed. It prescribes a standard diet and a standard time and method of eating. It prescribes the cut of the coat, the length of the dress, the fabric of the stocking. It prescribes the time, place and type of recreation according to social station. He who mocks the conventional standards of the time invites social ostracism, if not incarceration or death. From the standard birth and the standard cradle and swaddling clothes, to the standard after-life following the standard death and burial, the average human being is hedged about, controlled and regimentized by the

dictates of custom and convention evolved in the culture in which he finds himself.

Standardization of Devices

Standardized activity has, likewise, from the earliest times called into being standard devices, tools and equipment. The bas-reliefs on the Egyptian temples and monuments show not only standardized military action and worship, but also standardized bows and arrows, and a standard complement of equipment carried by each soldier. In a sense, one can almost say that we have here the first case of the manufacture of interchangeable parts, for the arrows could be used indiscriminately with the bows, and the parts of the bows were made to stock, according to the accepted modern fashion.

The tokens, icons, phylacteries and ephemera of the church, in any culture one may choose to examine, have by usage become highly standardized, and their manufacture, like that of war implements, has called into being industries concerned with the output of a highly standardized product. The Catholic Church has for centuries had definite specifications for the sizes, shapes and properties of candles, sacramental wines, church vestments, etc. Variation in the quality or in the dimensions have been subject to definite and prescribed limits.

When one passes from the production of such things as the above, to the production of the goods and services necessary for the building and upkeep of a city like ancient Rome, or modern New York City, it is easy to see that the ways and means by which those goods and services are manufactured and brought into use call for an elaborate set of devices and a high degree of specialization possible on such a large scale only when an elaborate set of standardized appliances and techniques are used.

Standard Weights and Measures

The standardization, through usage, of devices, tools and equipment for the accomplishment of some specific purpose,

calls constantly for units of comparison or points of reference—that is, standards of measurement. Standards of measurement, or standards of comparison of some form or other, are found in all societies. At first the unit of comparison may be some very crude and variable length, weight or quantity, such as the span, the foot or the horsepower units. By gradual refinement these units have been reduced to invariable proportions and are kept in constant relationship by reference to some single master standard. In turn they have become subdivided, and multiples of the unit have come into common use.

The history of standard weights and measures would be exceedingly difficult to trace, even were all the facts known, and they are not known. Suffice it to say that such measures have existed from very early times, and that in the course of their elaboration they have become one of the most important foundation stones upon which our modern complicated mathematical, physical and chemical sciences rest. Standard units of length and of weight, based, in turn, upon an elaborately worked out standard numerical system, made possible the development of the physical sciences at the same time that they gave precision to the making of tools and implements. Standard methods of testing, refining and working over metals made possible money systems based on metallic coins and promoted the science of metallurgy, without which the production of metals, underlying a vast proportion of the material achievements in war and peace since earliest times, would have been impossible on a large scale.

It would be possible to discourse almost indefinitely concerning the technical, the social and even the philosophical and religious significance of standards for comparison, or norms, as they might be called. All ethical, philosophical, religious and scientific systems have their standards or norms, without which they are not in the least understandable. Ritual, a code of conduct or a standard of living express adequately the concept of the term standard as a basis of comparison.

The technical significance of the slow but cumulative growth of knowledge about the uses of the many technical standards that were developed in the course of the centuries

can scarcely be over-estimated. The rise of the machine industry, which we associate with the so-called Industrial Revolution (1760–1830), was made possible, technically, by the existence of a vast number of standards, a considerable degree of information concerning the properties or physical constants of materials, and the freedom to apply these directly to the task of making machines for use in producing goods.

The Industrial Revolution and the Machine Process

It is not correct, of course, to trace the machine process, as an historical phenomenon, specifically to the Industrial Revolution. In the first place, machines existed long before the Industrial Revolution. The ancient ballista, the chiming clocks of Constantinople and the Germanic cities, the cannons so widely used in Europe by the beginning of the sixteenth century, were all machines. Even the use of non-human motive power is very old. Besides sails, windmills and waterwheels, we find steam used as a motive power very early. But the political, religious and economic environment of the time of the Industrial Revolution was radically different from that which had existed previously.

The significant fact about the Industrial Revolution, however, was that for the first time all the past accumulated knowledge, techniques and standards were brought to bear directly upon the process of devising mechanical means for producing goods. It is reported that a certain priest invented a steam engine during the early Middle Ages, but that he used it for the purpose of mystifying and frightening his parish into a penitent attitude. Had he lived during the period of the Industrial Revolution, he would have patented his invention and started a factory for the manufacture of pins, arms or some other salable commodity.

Standard weights and measures, technical information concerning the physical properties of materials (especially the metals), the classification and growth of information about the chemical elements (developed largely through the researches of the alchemists), the application of motive power, the substitution of scientific methods for rule of

thumb had all previously been matters almost entirely of scientific curiosity. During the early period of the Industrial Revolution, all this body of information came to take on a new and startling importance.

The Industrial Revolution was a revolution in methods and in point of view. As such, it involved applying to the machine the principles of standardization, many of which had been known for centuries. The most characteristic feature of the machine is its automatic, uniform, unvarying action under appropriate conditions. Within known limits the output will remain invariable, as the motions of the machine itself remain invariable. It operates efficiently—that is to say, without loss of time or effort—only under uniform conditions. Designed to perform a given task, it will perform no other. Its output is, consequently, a highly standardized one.

Like the output, the machine itself is composed of parts made under similar circumstances. Each part will cost less in time and effort if it is produced under conditions of invariable output. Likewise, the machine demands standardized raw material and is far more sensitive to variations in the characteristics of the materials upon which it works. As the machine process becomes more refined, the character of the material it works upon, the output and the process itself become more highly standardized.

The factory is but a larger expression of the machine process. Department is intermembered with department, process with processes and sub-processes in a neat "endless sequence." As industrial society becomes more complex, great geographic regions assume, in their industrial relationships, some of the characteristics of the machine process.

Standard input and standard output, standard processes fitted and intermembered by standard physical measurements are the essence of the machine process. It is not to be wondered at then, that the imaginations of industrialists, technicians and business men were so quickly caught by the possibilities afforded by ever-increasing standardization, made possible by the ever-increasing sway of the machine technology and the growth of mechanical invention. But understanding of standardization, *per se*, came more slowly.

Standardization Prior to the World War

This is not the place to elaborate upon the reasons for England's industrial leadership throughout the eighteenth and nineteenth centuries. As has frequently been pointed out, the setting in England was appropriate for the rapid extension of the machine process. Practically all of the mechanical principles embodied in the early machines were matters of common knowledge among the better-informed technicians of the day.

England in the latter part of the eighteenth century was already the commercial leader of the West. A century and a half of domestic peace in England at a time when Europe was constantly torn with civil and international wars; free mobile labor in large quantities; surplus money for investment purposes; supremacy on the seas at a time when the sea lanes were the safest trade routes; a large skilled artisan class due, to a considerable extent, to the immigration of Dutch artisans during and following the Flemish wars, and to the French expulsion of the Huguenots following the revocation of the Edict of Nantes; enormous, readily accessible and high-quality coal and iron ore deposits; large and fairly accessible markets, and many other factors of common knowledge contributed to the spectacular industrial growth of England during the eighteenth and nineteenth centuries.

By the end of the nineteenth century, however, the situation had become drastically altered. On the European continent, the growth of nationalism had succeeded in carving out a set of strong, centralized, and economically unified national entities. The period from 1848 to 1872 saw Germany, Italy and Austria-Hungary organized on a strong national basis. France, following the Franco-Prussian War and the establishment of the Third Republic, was for the first time since the beginning of the French Revolution placed on a firm political basis.

The United States had been growing rapidly, although up to the nineties its expansion had been largely agricultural. But by 1890, free land was a thing of the past. Industry as a whole, during the great westward movement, had grown slowly under changing tariff protection. The exhaus-

tion of free land changed the population drift from the land to the cities and caused, in turn, an unparalleled growth of urban centers.

By the turn of the century the states of South America had become fairly well settled politically. Sporadic revolutionary upheavals occurred in Mexico and the Central American States at a later date, but even in those states there were periods of political stability. Moreover, those upheavals were of minor importance and can not be regarded as representative of conditions in Latin America as a whole. With political stability came rapid growth of population and rapid economic development.

In the far East, Japan was rapidly forging to the front rank, politically and economically. And long before Perry "opened" Japan to the West, American, English, Dutch and French merchantmen carried on an active trade with the great Chinese seaports.

The last quarter of the nineteenth century and the first decade of the twentieth also saw the struggle between the European powers over the partition of Africa and, following that partition, the rapid exploitation of the continent.

All of these facts are, of course, matters of common knowledge to any schoolboy. But their significance lies in this—for the first time in many centuries, the known world was politically organized into definite imperial states whose political, military and naval power depended directly upon their respective industrial resources. The greatest market areas in human history were open for exploitation. Science, invention and the machine process had made mineral and chemical resources the key to power and had placed the well-being of the peoples within national borders.

In other words, the world was organized on a basis of mass markets, mass production and mass distribution. In the task of exploiting the resources of national and dependent territories, of refining, transporting, fabricating and distributing products, the machine technology played a dominant rôle.

Up to the opening of the twentieth century, markets were, in a broad sense of the term, unlimited. It was not a question of who could produce most cheaply, but who could

produce the most and sell the most. Throughout the nineteenth century, cheap manufacture was, consequently, not so important as rapid manufacture.

This same period was one of phenomenal growth of science and invention, with consequent elaboration of the possibilities of the machine process. With increasing rapidity, new inventions succeeded in breaking up old processes, which formerly necessitated considerable craftmanlike skill, into simple unit operations, subject to endless repetition and hence to machine methods. Scarcely, however, was a new process developed, a new machine invented, when another improvement rendered the old device obsolete. There was, accordingly, an enormous loss experienced in industry by the sheer fact of new technical changes. At the same time, the rapidity of development meant the growth of a multiplicity of devices for performing the same kind of operations.

That is, there was going on in the technical field a constant altercation between invention and standardization. Scarcely was a process standardized, the product made uniform, the raw materials shaped into uniform patterns for processing, before a new process or a new invention called for an entire reorganization of production. With the growth of technical information, however, it came gradually to be realized that it was possible to secure the "one best way," the "one best material" for a given product. With the perfection of devices, the increase in plant size and facilities, the economic necessity of coupling scientific information and standardization procedure became clearly apparent.

In other words, mass production made increasingly necessary the discovery of "best" materials, processes and devices, and increased standardization upon the basis of *deliberate* research. Where the product was of a complex nature or the machines used in processing consisted of a multiplicity of parts, convenience, if not economy, early made apparent the desirability of standardization of parts, which would make possible complete interchangeability.

Eli Whitney is sometimes called the "Father of Standardization" because he was the first to manufacture products on a large scale with the idea of complete interchangeability of parts.

"The Government gave him a contract in 1793 for 10,000 stands of arms, although he had no plant for their manufacture. He built a small factory in New Haven and began work but found a great obstacle in the difficulty of getting good workmen, especially those capable of acting as foremen under his novel methods. His plan was to make of his factory a single huge machine. . . .

"In an armory before Whitney's day each man, highly skilled, produced by himself a distinct part of a musket. This division of labor Whitney supplanted by so apportioning work that little or no skill was demanded. He separated the various tasks and at each of these operations kept a group busy. For their assistance he simplified each operation and introduced three aids, since indispensable in manufacture—drilling by templates or patterns, filing by jigs or guides and milling irregular forms.

"From first to last a model musket was copied with precision so that every lock, for example, was exactly like every other among thousands. When all the parts needed to form a weapon were assembled, they united much superior to a musket formed on any other plan. . . . In case of repair a new part exactly fitted the place of the old part and at a trifling cost."[1]

The railroads are another outstanding example of early standardization with the object of securing the maximum of interchangeability. In the early history of the railroads there were many different track gages, sizes and shapes of rolling stock, and patterns of parts such as couplings. Consequently, it was impossible to ship goods calling for transportation over more than one line without transferring the goods at every change of line. This was a costly and inconvenient business. By common agreement, first track gages, then boxcars and couplings, were made uniform and interchangeable.

This process of standardizing raw materials, machine parts, processes and products received increased emphasis as production units increased in size. As national and international competition for markets developed, certain competitive practices were recognized as extremely wasteful and expensive. The attempt to eliminate these practices led to the formation of combinations, mergers, trusts, cartels, and trade agreements of one sort or another.

The formation of these business combinations, brought about in the first instance by the desire more effectively to

[1] *New York City Sun and Globe*, Mar. 29, 1928.

control the output of a common product subject to a generally recognized set of standard processes, in turn accentuated that very tendency towards further standardization. Gradually the processes of unification and coordination, with the object in mind of facilitating mass production through standardization in the individual plant, were extended to embrace the major parts of whole industries.

But even this process was poorly coordinated and was carried out in a haphazard fashion. Agreement upon methods, practices, processes and units of measurement was difficult to get by common consent. More or less complete failure to understand what was going on, misunderstanding of motives, complication with other motives such as the desire to "rig" the market through monopoly control, and many other considerations slowed down the process to a snail's pace. Some single driving coordinating force was needed to accelerate the process, if mutual agreement were not to be a matter of decades, or even centuries.

Standardization and the World War

That centralizing, coordinating force was supplied by the World War. The World War was, in an unheralded sense, a war of mechanical devices and economic resources. It called for an organization of the belligerent nations that would bring every ounce of skill, every resource and productive energy to bear directly upon the main task—that of winning the War.

For generations, economists and sociologists have amused themselves by poking fun at the proposal of Saint-Simon to organize France on the plan of a factory, with centralized, coordinated, unified action of all the industrial power of the nation. But something of this sort was accomplished during the War, first by Germany, and then belatedly by the allied powers. At the beginning of the War, the German "War Machine" attracted universal attention and caused universal dismay by the sheer sweeping power of its brilliantly coordinated control. Resources were husbanded to the limit, there was a drive toward the elimination of all unnecessary waste motion, processes of manufacture were standardized in a quite new and astonishing fashion.

The Allies were slow in learning from German experience, but when they began to apply these same methods they applied them rigorously and in a sweeping fashion. The United States entered the conflict as this process of reorganization was going on, and turned to the task of efficient marshalling of resources with a vengeance since "Early thoughts on the question of supplies pointed to the fact that there would be shortages in a number of fields."[1] In July, 1917, the War Industries Board was organized for the purpose of controlling all purchases for war purposes, conserving resources essential to the prosecution of war, and carrying on a multiplicity of other functions calling for centralized control.

> "The War Industries Board, by means of its system of priorities, worked out a program for the operation of industrial plants on the balanced basis. It controlled the awarding of contracts, the fixing of prices, the allotments of raw materials, power and labor. Non-essential industries, such as super luxuries, were discouraged, essential industries were encouraged. Its economies through standardization and simplification of industrial products were very great. It saved 50,000,000 yards of wool, 260,000 tons of tinplate; cut the styles of stoves and heaters 75 per cent, eliminated 5,500 styles in rubber footwear, cut tire varieties from 287 to 32, cut shoe colors from 81 to 6, cut trunks to 6 sizes, reduced washing machine styles from 446 to 18, and eliminated 90 per cent of household wringer styles, cut pocket knives from 300 styles to 45, plows from 312 to 76, harrows from 589 to 38, and saved 600,000 barrels of flour by improved bread marketing methods. When the armistice was signed in 1918, the Conservation Division of the War Industries Board had prepared conservation programs for 269 industries. It was estimated that these programs would yield an annual saving of 15 per cent in the quantity of materials used in the United States."[2]

The result was, of course, an enormous increase in the productive capacity of the country. But the termination of the War brought on a period of severe strain. Domestic and world markets were disorganized; the monetary systems of the belligerent, and of some non-belligerent, powers were disrupted. Peace released from the armies hosts of workers seeking jobs. Industries specialized in producing to meet war

[1] Bernard M. Baruch, "American Industry in the War, a Report of the War Industries Board," Washington, D. C., 1921, p. 19.

[2] Stuart Chase, "The Tragedy of Waste," New York, 1925, pp. 8–9.

needs were forced to reorganize their productive operations and schedules to meet the needs of peace. The rather unexpected post-war business revival of 1919–1920 was followed shortly by the severe depression that reached its trough in the summer of 1921.

The Post-War Standardization Movement

With the publication in 1921 of the report of the Federated American Engineering Societies, "Waste in Industry," came renewed interest in ways and means for increasing the efficiency of American industries. This report, coming on the heels of war experience in the elimination of variety and the manifold advantages of systematic standardization, received a great deal of favorable publicity. It brought home with startling clarity the fact of widespread lag, leak and friction in the workings of American industries.

This country has long been the home of mass production. The nature of our great domestic market, the wide expanse of land within a single sovereign state, a well-built and elaborate railroad system, a population drawn largely from the lower and middle classes of Europe have afforded unparalleled opportunity for the development of mass production. Now mass production calls for elaborate plants, machinery and other equipment, and consequently for heavy investment. That is to say, mass production involves increased overhead expense and decreased variable expense. This shift in the nature of the costs of doing business—costs which tend to remain relatively constant whether production is going on or not—has gradually shifted attention to the problem of eliminating every conceivable expense incident to machine processing and to the regularization of business. Attention to these problems was sharpened by the growth of more accurate cost accounting methods and of statistical information concerning the nature and interrelationships between business fluctuations—secular, cyclical, seasonal and irregular.

The post-war situation brought added incentives for the careful scrutiny of the problems of simplification and standardization for the purpose of eliminating costly wastes and

facilitating mass production. The reparations debts to be paid by Germany to the Allies could be paid in the long run only in goods. With rehabilitation of the German monetary system, and, shortly after, the attempted systematization of the reparations problem through the adoption of the Dawes Plan, Germany settled down in earnest to the task of payment of the indemnity. But the payment called for an export value surplus, which Germany could achieve only by underselling its commercial rivals— Great Britain, France, Italy and the United States. These countries, the future recipients of the reparations, in order to protect their own disorganized industries and markets, imposed tariff barriers against the flood of cheap German goods. Needless to say, this action necessitated still cheaper production in Germany in order that its goods might climb over the tariff walls.

The competition of Germany was in due time to be duplicated by international competition brought about by the belated payment of interallied debts by value surplus of exportable goods to the creditor countries. Meanwhile, international competition took the form of concerted national movements to regain markets formerly held and to keep present markets by producing cheaply at home—and, under large-scale industry, that means by realizing the economies of mass production through rigid standardization and simplification.

A number of the larger industrial concerns, both here and abroad, set up their own standards departments. The rapid growth of trade associations and industrial mergers in this country, and the renewal of the cartel movement in Europe, made possible standardization and simplification throughout entire industries. But the development of standards by individual concerns and by many different trade associations produced, in turn, a profuse variety of standards relating to the same industries. The need for some central clearing house for coordinating the various standards movements has become universally felt.

To meet this need, national standardization committees or associations have been organized, largely since the war, in practically every important industrial country. Before

the war there was but one such organization, the British Engineering Standards Association, organized in 1901. However, its activities, up to the time of the war, were rather restricted in scope.

Hand in hand with this movement has gone the development of international standards bodies, whose work, however, has been rather closely confined to the standardization of highly technical matters. The first of these bodies was the International Conference on Weights and Measures, organized in 1875, and the most recent is the International Standards Association, now in the process of formation.

CHAPTER II

TERMINOLOGY OF STANDARDIZATION

MUCH of the confusion about the facts of standardization has arisen because of the lack of a clear understanding of the meaning and scope of terms. People have not been talking the same language and the terms used have carried different ideas to different persons. The content of the term standard has already been hinted at in the first chapter. Fortunately, while phraseology differs widely, the basic concept underlying the use of the term is quite definitely established. A survey of the literature on standards and standardization will show fairly close agreement with the definitions given in Funk and Wagnalls, appropriately-titled "New *Standard* Dictionary":

> "Standard: (1) Any measure of extent, quantity, or value established by law or by general usage and consent; a weight, vessel, instrument, or device sanctioned or used as a definite unit, as of value, dimension, time, or quality, by reference to which other measuring-instruments may be constructed and tested or regulated.
>
> "(2) Hence, any type, model, example, or authority with which comparison may be made; any fact, thing, or circumstance forming a basis for adjustment and regulation; a criterion of excellence; test; as a standard of portion by weight of fine metal and alloy established by authority."

The dictionary cites Steele[1] to the effect that, "The first intimation that is given of an attempt to have a standard in England, is that of 1120. King Henry ordered that the ell, the ancient yard, should be the exact length of his arm." That is, the arm of King Henry was made a standard unit of comparison of lengths throughout the kingdom. Should the arm vary, the standard would vary; should the arm remain constant in length, the standard would remain a constant unit for comparisons of length.

This example well illustrates one of the principal confusions

[1] J. D. Steele, "Natural Philosophy," London, 1872, p. 15.

that arise in the interpretation of the term. Are standards constant, or may they vary? If they are permitted to vary, are they any longer standards? There is nothing in the dictionary definition given above that compels the interpretation of invariance over a period of time or for universal application. Custom or law may change or may be different from place to place. New standards may supplant old standards; but at a given time, in a given place, and with a given individual or group of individuals, the standard must not vary, since by definition a standard is a "unit," a "basis," a "criterion" for measuring, reference, comparison or evaluation, and these terms, in order to have any significance at all, must remain constant for the time being.

In this same connection Alfred Marshall[1] differentiates between "particular" and "general" standards. The former he regards as that most satisfactory shape, size, or process evolved by a particular individual deviating away from socially-accepted standards in the act of invention or innovation. If the "particular" standard commends itself widely to contemporaries, it becomes accepted as a "general" standard for the whole group.

The more widely accepted particular standards become, the greater the difficulty in keeping the standard constant. In matters that relate to social customs, legal conventions, relationships between groups or individuals in their economic, political, ethical or cultural aspects, interpretation is continually working over old standards until the new bears scarcely any relationship to the old. In the technical fields of the so-called "exact" sciences, the matter is slightly different. Units of measurement, weights, physical constants, etc., must be kept as near constant as is humanly possible. Constant units of weights and measures are one of the main pillars upon which modern science, technology and industry rest. The slightest deviation in a unit of measurement possesses great significance where measurements are made to a ten-thousandth of an inch.

Between these two extremes—the standard of conduct or the social conventions, and precise standards of physical measurements—comes practically the whole of the standards

[1] Alfred Marshall, "Industry and Trade," London, 1921, pp. 201–202.

dealt with in the so-called "standardization movement." Industrial standards are concerned with the *uniform*, the *widely accepted*, and the *best* for the time being, even though that best may be only a "practical-best," arrived at as the product of a compromise of interested parties. Once set up, the standard may remain constant over a long period of time or may be subject to frequent and drastic revision.

Meaning of Standardization

Although the dictionary says that standardize means "to make to conform to a standard," and standardization is the noun for standardize, there is no such agreement on the term standardization as was found with the term standard. Disputes about the term seem, however, to center around two issues—first, as to whether standardization is a survival process or one of conscious deliberate selection, and second, the scope of the term.

Strictly interpreted, to regard as standard whatever has survived is to regard everything that exists in the natural and social worlds as standardized. If survival is a process of standardization, whether by natural or artificial selection, then the products of mutation and differentiation, the thousands of idiosyncrasies that have crept into speech, law and custom must be regarded as the products of standardization. Broadly speaking, however, this concept is the basis of a great deal of what might be termed "deliberate standardization," of which the simplification program of the United States Division of Simplified Practice is a good example.

Albert W. Whitney has elaborated this broader use of the concept of standardization by survival, by drawing comparisons between processes in the world of nature and of man:[1]

> ". . . nature, uncontrolled, would fill the world with endless variety. There would not only be the myriad types that we now have but innumerable modifications of those types. Natural selection, however, acting upon this variety, has had the effect not only of choosing certain types as worthy to survive but of endowing these types with a certain degree of permanence and stability and isolation.

[1] Albert W. Whitney, "The Place of Standardization in Modern Life," Inter-American High Commission, Washington, D. C., 1924, pp. 2–3.

It is as though nature had not only given each type a chance to survive but had gone further and cleared out the weeds near by so as to give it the best possible opportunity to get light and air.

"The effect is that nature, instead of filling the world with a continuum of plants and animals, has filled it with a discrete and actually enumerable assemblage of types, and furthermore, an ordered assemblage, each of which has a considerable degree of stability and among which certain type-conserving forces operate, such as those that inhibit miscegenation.

"Now this establishment of a system of discrete and enumerable types in nature is the exact analogue of standardization as a purposeful, human activity, and the two are subject to the same abuses.

"Not only has nature developed types which can be enumerated and classified, but she has standardized for each a multitude of organs and functions. Individuals of the same species resemble each other in the minutest details of structure and function. If this were not so, organized life would be practically impossible. Everything would be an individual problem with no possibility of generalizations. Institutions and customs would be impossible, for institutions and customs and laws depend upon an underlying sameness of reaction. There could be no medicine for there would be no uniformity of physical organization or response; there could be no surgery, for the surgeon would not know whether he were cutting into a heart or a liver; there could be no organized education, because each mind would be an educational problem in itself. An underlying sameness is the basis for every civilization."

The same idea is expressed in the Standards Yearbook:[1]

"The beaten path is the standardized path, beaten smooth by footsteps which stabilize their own standards as the river cuts the channel which guides its flow. Human action, too, beats its trail into habits—standard reactance with its economy of time and energy and its skill stored in neural arcs and automatic responses. Language is a standard vehicle for the commerce of ideas for which the alphabet gives standard symbols. Words are standard symbols of standard concepts."

Somewhat different are those definitions that regard standardization as a process of conscious, rational selection. Colonel E. C. Peck,[2] for example, regards standardization as "the selection of a small number of types or sizes which

[1] U. S. Dept. of Commerce, "Standards Yearbook, 1928," Washington, p. 3, hereafter referred to as "Standards Yearbook," to differentiate from the "Yearbook" of the American Engineering Standards Committee. Note—The name of the American Engineering Standards Committee was changed last year to American Standards Association, and that name will be used in all subsequent references to the organization save in footnote source references to publications.

[2] Col. E. C. Peck, "Standardization and Its Value to Cleveland Industries," *Cleveland Engineering*, Oct. 7, 1926, p. 3.

are most suitable and giving specifications of them in measurable terms so that large quantities can be made which will be uniform." In another place[1] standardization is defined as, ". . . . an active principle in the conduct of business and as such deserves and needs a standardized procedure. Chaotic, chance, and individual standards must give way to those formulated in an orderly and efficient manner wherein the process is continuous to the degree economics and service needs require revisions to be made."

It is in this latter sense, that of conscious, deliberate, selection of materials, sizes, products, means and processes, that the term will be used in this book. Whether the deliberation, prior to selection, rests upon a study of ways, means and products most widely used or in demand, or upon a careful, systematic and thoroughly scientific examination of properties and processes in order to determine the "best" standard, does not make much difference for the purposes of this book. In both cases the fact of deliberate investigation and comparison of alternatives, and the deliberate endorsement of a particular unit or process, whether a product of compromise or not, is patent and uppermost.

Standardization, Waste and Efficiency

With the growth of a body of standards that are selected by deliberate action from a group of alternative possible standards, other ideas have obtruded themselves into the discussion. Among these, perhaps the most important is that of an "efficient" standard, to be used in the process of eliminating "waste." The following definitions bring this fact out with the greatest clarity:

> "Standardization is synonymous with fitness to industrial conditions. . . ."[2]
>
> "The function of standardization is economy."[3]
>
> ". . . a standard should deviate to the least possible extent from economical current practice. . . ."[4]

[1] Division of Simplified Practice, *Monthly News Bulletin*, Oct. 15, 1927.

[2] *Electrical World*, "Order and Authority Needed in Standardization," Mar. 26, 1927, p. 643.

[3] E. C. Stone, "Standardization and Progress," *Electrical Journal*, May, 1926, p. 208.

[4] F. J. Schlink and J. G. Gaillard, *Mechanical Engineering*, April, 1927, p. 305.

> "Simplification[1] . . . has to do with the elimination of superfluous sizes, dimensions, types, etc., of every-day commodities, for the purpose of reducing costs all along the line."[2]
>
> "Standardization can be referred to as a means of getting things done in the easiest, quickest and most successful way with the least effort and thought possible."[3]

This notion of efficient standards for the elimination of waste has different meanings to the engineer and the business man. To the engineer they are standards of mechanical efficiency, and to the business man they are standards of pecuniary efficiency, or "commercial standards," as they are termed by the Bureau of Standards.

To the engineer, as such, efficiency may mean one of three things: (1) current efficiency, (2) realizable efficiency, and (3) ideal efficiency. Suppose the "input" of material into an engine to possess a certain quantum of thermal energy. The "output" of precisely the same amount of energy by the machine would represent "ideal" or 100 per cent efficiency. Suppose, however, that rated on the basis of 100 per cent "ideal" efficiency, a machine contrives to deliver at the rate of 30 per cent. The device can be improved, let us say, so that the rate of efficiency can be brought up to 40 per cent of "ideal." On this basis, 30 per cent efficiency represents current efficiency; 40 per cent, realizable efficiency.

Since in engineering terms waste can be defined as the loss of efficiency, 100 per cent efficiency would mean no waste; 30 per cent efficiency, 70 per cent waste; 40 per cent efficiency, 60 per cent waste. Preventable waste would equal the difference between current and realizable efficiency, or, as in this case, 10 per cent.

It is this last quantity that the engineers have in mind when they speak of preventable or avoidable waste, or, for general purposes, "waste." The report of the Federated American Engineering Societies, "Waste in Industry," repeatedly speaks of "preventable" and "avoidable" waste. They are referring to that 10 per cent or, to put it in other

[1] Simplification means standardization of type in this study.

[2] W. W. Ely, writing for Herbert Hoover, Secretary of Commerce, Oct. 12, 1926, to A. C. Sorenson. Copy from files of American Standards Association.

[3] Stanley Green, "Relationship of Engineering Standards to Accident Prevention," *National Electric Light Association Bulletin*, May, 1928, pp. 293, 294.

words, to that loss of energy, skill and time equal to the difference between the best, or best feasible, practice, process and method of production, and the current practices, processes and methods.

To the business man, waste means business inefficiency—that is, costly business. One hundred per cent efficiency in business would be obtained when costs were at an "ideal" or lowest possible point; current efficiency is the present pecuniary outlay for the present pecuniary income; and realizable efficiency, the most efficient conduct of business possible with known methods, techniques and processes. Preventable waste is equal to the difference between current outlay and the smaller amount that would be necessary were a change in methods introduced. One way of bringing about this felicitous result is by the adoption of standards in the technological processes of the industries it is their business to manage and exploit. These standards have recently earned the name "commercial" standards.

In recent years, business reasons for adopting the technical standards worked out by the engineers have been increasing. The standardization movement has consequently taken on a dual rôle, in which the business forces of the community, interested in cutting costs to a minimum, are becoming the dominating factor.

Where the term waste is used in this book, it will mean "preventable" waste. Where the term efficiency is used, it will mean "realizable" efficiency, as defined above. In all cases, unless otherwise specifically indicated, the terms will be used in connection with business efficiency, business waste. That the business and the engineering approaches achieve identical results in many cases should be apparent, but it may serve to clarify the discussion if the difference in approach is kept clearly in mind.

The Scope of Standardization

The Year Book of the American Standards Association for 1928 defines the scope of the standardization movement to include the following types:[1]

[1] American Engineering Standards Committee, "Year Book, 1928," New York, p. 9.

(1) Nomenclature
  Definitions of technical terms used in specifications and contracts and in other technical work.
  Abbreviations
  Symbols for quantities used in equations and formulas.
  Graphical symbols (ideographs or pictographs).
(2) Uniformity in dimensions necessary to secure interchangeability of parts and supplies, and the interworking of apparatus.
(3) Quality specifications for materials and equipment.
(4) Methods of test.
(5) Ratings of machinery and apparatus which establish test limits under specified conditions as a basis of purchase specifications, or which establish requirements as to performance, durability, safety, etc., under operation.
(6) Provisions for safety.
(7) Rules for the operation of apparatus and machinery in industrial establishments.
(8) Concentration upon the optimum number of types, sizes, and grades of manufactured products. (The Division of Simplified Practice uses the term "simplification" for the elimination of unnecessary types, sizes, and grades, this selection being based upon relative commercial demand.)

Since the content of these various types of industrial standards are not always clear to the uninitiated, it will be worth while to elaborate them somewhat by an explanation of some of the less familar terms and by the use of illustrative material. Considering them in the order given above:[1]

(1) The use of ambiguous, misleading and provincial terms, symbols, abbreviations and graphic representations in many branches of industry is a matter of common knowledge. Even the layman on the street is familiar with the fact that a profusion of terms prevents him, quite frequently, from determining the exact nature of the thing he is buying. The Federal Trade Commission reported that such Philippine woods as red lauan, white lauan, tanguile, narra,

[1] Unless otherwise stated, illustrative material is here drawn from "Yearbook, 1928," *op. cit.*, pp. 28–53.

apitong, bataan, lamao, almon, orion, batang, bagaac, batak and balachacan were all sold on the market as "mahogany."[1] The National Better Business Bureau found that few consumers[2] know what is meant by "part wool," and of course no one knows what is meant by "best quality," as advertised.

It is the clarification of all technical terms at the source that is the subject for the standardization of nomenclature. All of the chief engineering societies have done some work in this field. Recently the work has been taken up by trade associations, and it is now becoming centralized in the American Standards Association. Among its standardization projects, the Association lists in its "Yearbook" the following projects on nomenclature: Electrical Engineering Definitions; Radio; Scientific and Engineering Symbols and Abbreviations; Symbols for Hydraulics, Heat and Thermodynamics, Aeronautical, Electrotechnical, Navigational and Topographical; Standards for Graphics; Standards for Drawings and Drafting Room Practice.

The term "specification" deserves clarification.[3] In the simplest terms, a specification is simply a statement, written or verbal, "specifying" what properties—physical, chemical, artistic, etc.—the desired article must possess in order to be acceptable to the purchaser. "The purpose of any specification is to make known to the manufacturers to whom it is sent the exact nature of the apparatus or equipment upon which they are to quote."[4] Some of the large producing firms in the United States purchase the bulk of their supplies on specification. The Federal Government purchases the greater part of its supplies by specification and not by brand or trade name.

(2) The second form of standardization is sometimes called "dimensional" to distinguish it from standards of quality, safety, simplified practice or methods of operation or test. From an engineering point of view, dimensional standards are the first fundamental in the standardization program. Ger-

[1] U. S. Dept. of Commerce, *Domestic Commerce*, June 11, 1928. [2] *Idem.*

[3] See Appendix A for the properties of a good specification.

[4] American Engineering Standards Committee, *Sustaining Members Bulletin*, Feb. 14, 1928.

man standards are, for example, almost entirely "dimensional" standards. It is from dimensional standards, which are indispensable for mass production under modern technical conditions, that most of the "savings" due to standardization are claimed. Complete interchangeability of parts over the widest geographic area is its ultimate objective.

Such projects of the American Standards Association as those on Ball Bearings, Plain Limit Gages, Gears, Pipe Flanges and Fittings, Shafting Pins and Washers, Dimensions and Material of Wrought Iron and Wrought Steel Pipe and Tubing, Rails, Motion Picture Machines and Films, illustrate this type of standardization.

The establishment of dimensional standards calls into existence systems of tolerances. In non-technical terms, a "tolerance" means simply the stated amount of deviation away from the standard that will be tolerated by the purchaser in writing his specification for standard materials. "The permissible total variation in the size of a part is called the 'tolerance' on its size. Two extreme sizes, a large and a small one, form the boundaries of the tolerance; these are the 'manufacturing limits' or briefly, 'limits.'"[1] Tolerances are of two sorts, unilateral and bilateral. A unilateral tolerance is given in one direction from the basic size of a part, while a bilateral tolerance consists of two permissible deviations in opposite directions from such basic size. Unilateral tolerances are the more widely used; in recent years they have gradually gained ascendancy over bilateral tolerances in nearly all of the great industrial countries. In fact, the only national standardizing body that even mentions bilateral tolerances is the British Engineering Standards Association, which strongly recommends unilateral tolerances.

(3) Whenever the chemical or physical properties of the materials desired are of significance, specifications list the minimum, and sometimes the maximum, qualities—tensile strength, degrees of hardness, chemical purity, coloration, etc.—that the commodity delivered must possess. These quality specifications are sometimes supplemented by what are called tolerances, but the term tolerance when

[1] John Gaillard, "Gages as an Instrument in Mass Production," *The Annals of the American Academy of Political and Social Science*, May, 1928, pp. 138, 141.

used in this connection includes quality as well as dimensional variations. Thus the Bureau of Agricultural Economics, in working out quality standards for agricultural products, establishes tolerances, or permissible deviations from standard.

As the needs and demands of industry are becoming more precise and better known, materials of all sorts and varieties are falling under the domination of quality specifications. Among others, the American Standards Association Yearbook mentions the following standards projects already worked out or to be worked out under this head: Specifications for Portland Cement; Tubular Steel Poles; Refrigerators; Sheeting; Trackwork; Zinc Coating of Iron and Steel.

(4) The drawing of quality specifications necessitates either the testing of all the commodities delivered under the specifications, or of samples of the total delivery. Where the types of materials delivered under the specifications are of such a character that testing requires a considerable degree of scientific information and skill, efficient handling of the testing problem necessitates standard, uniform and strictly comparable tests. Standard methods of test are becoming of increasing importance in a large number of fields. The American Standards Association Yearbook lists the following (taken at random) standards projects concerned with methods of test: Chemical Analysis of Alloys of Lead, Tin, Antimony and Copper; Methods of Test for Flash-Point of Volatile Flammable Liquids; Zinc and Zinc Ores; Safety Code for Automobile Brakes and Brake Testing; Specifications for Fire Tests of Materials and Construction.

(5) Purchase specifications, demanding certain definite properties in the materials delivered, and followed up by testing in the plant of the purchaser, would place extraordinary burdens on the shoulders of the producer if the devices, techniques and apparatus are used in the process of testing the delivered goods did not give the same results in testing identical materials. In order that sub-standard materials be not accepted, or standard materials rejected, because of faulty apparatus used in testing, the apparatus

used must have a uniform rating. Uniform rating here is just as important as uniform weights and measures in dimensional standardization. This type of standardization involves, also, the setting up of standard and uniform methods of rating machinery according to its efficiency in operation, useful life, safety of operation, etc. The American Standards Association standards include rating projects for Radio, Electric Meters, Electrical Control Apparatus, Electrical Machinery, etc.

(6) Standard safety codes cover a wide range of industrial activity. Standardization in the United States has probably been carried further in this field than in any other, with the possible exception of dimensional standardization. The Federal Bureau of Mines, the American Standards Association, practically all of the great engineering societies, the Underwriters Laboratories, the National Fire Protection Association, trade associations and private companies have actively cooperated in this work. Safety codes now exist for most of the great industries.

(7) Standard rules for the operation of apparatus and machinery are closely related to scientific management. They are distinguished, however, by the fact that they are concerned with the technological features of the operation of apparatus and machinery. Codes, rules, or instructions for the setting up and operation of machinery of all sorts have been standardized, although comparatively little national effort has been made to establish national standards in this field.

(8) Standardization of type is sometimes called "simplification." The Germans call it "typification." There have been not a few writers who have maintained that simplification is not standardization at all. Ray M. Hudson differentiates the two as follows:

> "'Simplification' and 'standardization' are not synonymous terms. Each describes a separate and distinct process. *Simplification* is defined as the art of rendering simple, or more simple, or making less complex, or less difficult, while *standardization* is defined as the art or process of conforming to any measure or extent, quantity, quality, or value, established by law, general usage, or consent."

[1] Ray M. Hudson, "Simplification and Standardization," in "Management's Handbook," New York, 1924, p. 689.

In another place Hudson quotes from A. W. Shaw, to the effect that "Simplified practice is based not upon research but upon present practice, and refers alone to elimination of excess variety."[1] And again, a statement that simplification can be defined as "that policy of management which seeks to conduct all activities, and perform all functions of an enterprise in the least elaborate manner consistent with any given purpose."[2]

Cecil Chisholm[3] regards standardization as a subdivision under the broader head of simplification, while Gushee and Boffey[4] consider simplified practice to be but a part of standardization. Whatever be the merits of the respective sides of this controversy, it seems to be more a verbal one than a question of the content of simplification.

The work of the Division of Simplified Practice has been mostly confined to the elimination of what they term "immaterial" or excess variety, the elimination of which involves no technical principles and does not result in the selection of a technically "best" standard variety. As such, simplification consists of the selection of those sizes, shapes and varieties in most general use, for which the demand is the greatest. While from the engineering and the economic points of view this single criterion may seem inadequate, the Division of Simplified Practice has not seen fit, to date, to go further into the problem.

Despite the emphasis placed upon the view that simplification is something separate and apart from standardization, the mass of the evidence does not seem to support that view. In fact, the term was coined by Herbert Hoover, who was anxious to avoid the use of the term "standardization" because of irritating connotations the latter had for uninformed persons.

But at best, the differentiation can hold only as between "scientific" and unscientific, or studied and rule-of-thumb selection, for all standardization involves the selection of certain types, sizes and methods out of the wilderness of

[1] *Ibid.*, p. 690. [2] *Idem.*

[3] Cecil Chisholm, "Simplified Practice," London, 1927, p. 111.

[4] Edward T. Gushee and L. F. Boffey, "Scientific Purchasing," New York, 1928, pp. 41–42.

possible choices. Hudson himself, once he has gone beyond the preliminary stages of his differentiation between simplification and standardization, constantly reverts to the use of the terms "standard," "standardize," and "standardization" in the discussion of simplification.[1]

In this study, consequently, simplification will be thought of as non-scientific standardization of type—an integral part of the broader standardization movement, but based on sales data and experience. At times it will be convenient to speak of simplification as a movement in itself, but in a manner no different than that in which any of the eight abovementioned types will be discussed.

Classification and Grading

There have been some writers who are not certain that the terms classification and grading should come under the heading of standardization at all. The American Standards Association and the Hungarian Engineering Standards Committee,[2] however, are working out "standard classifications of coals," and the Canadian Engineering Standards Association[3] published in March, 1926, a "Standard Classification of Items for Highway Expenditure." This latter "provides for a uniform system of accounting in connection with highway construction contracts." The uniform cost accounting system in use among American railway systems also provides for a standard classification of items.

The Federal Grain and Cotton Standards Acts set up systems of classes and grades, which were made uniform throughout the United States both in interstate commerce and in the export and import trade. The Bureau of Agricultural Economics has set up numerous standard systems of classes and grades. Indeed, there seems to be a quite general agreement as to the content of the two terms. The following statement is typical:[4]

[1] See, for example, his article in the *Annals*, *op. cit.*, May, 1928.

[2] Victor S. Karabasz, "Simplification and Standardization in Europe," *Annals*, *op. cit.*, May, 1928, pp. 25, 30.

[3] B. Stuart McKenzie, "Canadian Engineering Standards Committee," pp. 17, 20.

[4] U. S. Dept. of Agriculture, "Market Classes and Grades of Beef," Bulletin No. 1246, p. 1.

> "Classifying and grading a commodity consist merely of dividing it into lots or groups which have similar and uniform characteristics, and which show minimum variations in the essential factors which distinguish the group from other groups. It is an analytical process, going from the general to the particular, a grouping of individual units in such a way that they present the greatest uniformity possible.
>
> "Classifying and grading are complementary terms. Both are part of the same general process, but classification precedes grading. For example, all beef is first divided into a number of large units, such as steer beef, cow beef, bull beef, etc. These general units are called classes. That done, each class is still further subdivided into smaller and more specific groups, such as prime steer beef, good steer beef, medium steer beef, etc. These small units are called grades."

When the classes and grades have been worked out to a satisfactory conclusion, they are used as the basis for the drawing of specifications for purchase of government food supplies. They are also used as the basis for federal food inspection where the goods are in interstate commerce, and in the export and import trade. They have been given wide publicity by the Bureau, and are now the basis for standards set up for inspection of foodstuffs in several of the states and large cities.

Standardization and Scientific Management

Scientific management is concerned with standards, and has a standardization program of its own, but those standards and its standardization program are much broader in scope that the types of standardization with which this study is concerned. H. K. Hathaway[1] classifies the standards of scientific management under the following headings:

Equipment, including machines, tools or implements, facilities for handling, transporting or storing materials, *materials*, *method*, *accomplishment*, and *product*.

In its broadest aspects scientific management covers all these fields. Standardization as discussed above deals with equipment, materials, methods and products. It is upon these standards that scientific management rests its fundamental procedure. "Standards of accomplishment are dependent upon standards of equipment, materials, methods and product. . . . there can be no standard or uni-

[1] H. K. Hathaway, "Standards," *Bulletin of the Taylor Society*, Oct., 1927, p. 491.

formity of accomplishment without standardization of all of the conditions under which the work is done."[1]

In its narrower connotation, scientific management as a separate movement is concerned only with "standards of accomplishment," based fundamentally upon time and motion studies, where the human element—the operative, machine or process tender—is the focal point of attention.

The literature of scientific management is replete with studies of the best ways of *doing a job.* While by no means ignoring the other factors, scientific management concentrates its attention upon the systematization, regularization, routinization of the job of the operative, with the object in mind of facilitating to the utmost the speed and efficiency of the worker, whereas standardization of the variety with which this study is concerned concentrates attention upon uniform and simplified ways and means of a technologic nature, usually involving tools and devices and designed to provide accurate and efficient modes of securing results that eliminate waste motion and waste effort. Even standard methods of test and safety codes are concerned with the broad impersonal delineation of technical ways and means rather than with the operations of the individual technician or worker in the process.

There is, however, a very close relationship between the work of the two movements. The one leads logically to the other wherever technical equipment is used by human labor. Wherever the technical appliances are simple and of comparative unimportance, standardization becomes a matter almost entirely of scientific management.

There is one important difference between scientific management and standardization arising from this difference in emphasis. In the one case, we are dealing with inanimate, or nonhuman, objects; and in the other, with the human agent. The two can not be treated in the same way since quite different problems arise in the two cases. The closer the rapprochement between the two movements, the less important this differentiation will become. This study, however, will ignore scientific management as much as possible, not because it is considered unimportant but because

[1] *Ibid.*, pp. 491, 492.

of the different types of problems raised and because scientific management is an exceedingly complex and diffuse field in itself.

Standardization and Rationalization

Somewhat the same generalization can be made for what is coming to be known quite generally in Europe, particularly in Germany, as "rationalization."

> "In its broad German conception, rationalization includes standardization and simplification, reduction of waste and scientific management, labor-saving equipment, reduction of overhead cost, economy in selling, and finally, and highly important from our point of view, the consolidation of corporations with all allocation of production and the closing of uneconomic industrial units. The program as a whole has a familiar sound to American industry, but it is a new factor in Germany, a constructive policy of internal reorganization that has not only gripped industry but has enlisted the sympathy and cooperation of labor and the public.
>
> "There is a national committee that encourages standardization in all its ramifications throughout industry. Nearly two thousand standards have already been approved, covering materials, equipment and methods. In fact this phase of rationalization has been carried into minute details that would seem to us of minor importance."[1]

The revival of cartels, industrial mergers and combinations, pooling agreements, etc., are important features of the rationalization movement. So important a feature has this part of the movement become that it has come to occupy the center of the stage in many discussions of the program to eliminate waste on a national scale. An American Standards Association bulletin refers to it as:

> ". . . the concentration of a country's economic resources in the hands of those industrial combinations most competent to use them, and the modernization of industrial plants and processes. Such rationalization postulates every form of cooperative activity from the formation of selling combinations to the actual amalgamation of business, to the end of eliminating all wastes arising through uneconomic types of competition."[2]

In a sense, it represents a fulfillment of the old idea of Saint-Simon who proposed to organize France as a national

[1] U. S. Dept. of Commerce, Division of Simplified Practice, *Monthly News Bulletin*, Sept. 15, 1927.

[2] *Sustaining Members Bulletin*, *op. cit.*, Feb. 14, 1928.

factory after the French Revolution. A similar conception of the marshalling of industrial resources, skill and energy underlies the Russian Gos-Plan. The recent report of the British Liberal Party, "Britain's Industrial Future," lays down the tentative outlines for some such national co-ordination and unification of the nation's industries. There are, of course, considerable differences between these latter proposals and the rationalization movement as it is developing in Germany, with respect to the initiating and controlling authorities. While the German movement proceeds in cooperation with the government, and the plan of the British Liberal Party anticipated a considerable measure of government regulation, the Russian Gos-Plan proposes to put the entire movement under the leading-strings of the government. But in their technological features, all three are proceeding along similar lines.

It is obvious, of course, that a study of rationalization would carry this investigation far afield. It is standardization, scientific management, unification carried out on a broad national, and in some cases, international basis. Consequently, while we shall have occasion to deal with certain aspects of rationalization, this study can in no wise be considered a study of that subject. Standardization as a conscious deliberate policy involves the rationalizing process, and to a certain extent all standardization is a manifestation and a part of rationalization. But the popular use of the term "rationalization" is much broader.

The term "unification" has sometimes been applied to standardization, principally by the British, in an attempt similar to that made by Herbert Hoover to supplant the term "standardization" by a more acceptable word.[1] Otherwise the term is used vaguely to mean the reduction of the many to one (unus), and the tying-up, unifying process that is inherent in standardization of any sort when it is introduced into the industrial process. Standardization necessitates closer coordinating, more careful intermembering, more systematic unification. Unification is more truly a result or a characteristic of standardization.

[1] See, particularly, the speeches and writings of Mr. C. Le Maistre, Secretary of the British Engineering Standards Association.

CHAPTER III

COMPANY STANDARDIZATION

THE issue before the modern business executive is not standardization, but how much standardization. Whether the business executive realizes it or not, any form of definite organization used in the pursuit of business ends involves the use of standards and the standardization of business procedure.[1] Still more is this true in the organization of machine industry. As indicated above, the machine, however specialized in itself, is an automaton, and its output is a highly standardized product.[2] Variations in the output of the machine are subject to known, calculable limits. By change of design, re-arrangement of apparatus, alteration of speeds and timing, the output of the machine may be rendered variable, but with each set-up it turns out systematically a uniform product.

What the business executive must decide, then, is the question, "To what extent do the exigencies of my particular industrial undertaking call for more or less standardization than I already have?" His answer will vary, depending, in the first place, upon his knowledge of the nature of the materials and markets from which he draws his supplies for manufacture, and of the market for his finished product, as well as upon the processes and the possibilities of economical manufacture in his own establishment, and, in the second place, upon his plans for the future.

[1] "Only when things are standardized can they be fitted together. When many men are standardized to walk and march together in obedience to the same standardized commands, a mob becomes an army. A machine can be made from many pieces because each piece has been standardized. We work together with other persons only when we know that their habits in regard to that work have been sufficiently standardized to enable us to know in advance what their actions will be. If an industrial organization works smoothly, it is because many things have been standardized." A. M. Simmons, "Production Management," Business Management Series, Vol. I, Chicago, 1922, p. 72.

[2] See Thorstein Veblen, "Theory of the Business Enterprise," New York, 1904, Chap. II.

Stated briefly, the purpose of standardization in an industrial program,[1] as of any other business policy, is efficient, economical production, with an eye to the widest possible sale of the product at a price which will bring the largest net return upon the capital invested. John C. Shover states the case clearly: "The purpose of standardization is to effect, in a plant or industry, uniform adoption of the most economical and useful materials, machinery, equipment, processes, methods, and practices of production and distribution, and to maintain definite and suitable quality of products consistent with the economies and uses desired."[2]

The Issues in Standardization

Assuming, for the time being, that standardization accomplishes what is claimed for it,[3] the issues involved in the introduction of standards are fairly clear and definite. There are at least five questions the industrial executive must answer in planning further standardization in his industry:

(1) Shall standardization be a conscious, selective, deliberate process, or shall it be by the "trial and error" method—accidental and haphazard?

(2) Shall standardization be based upon a careful scientific investigation, involving research and the use of laboratory and technical staff, or shall it be based upon the "common-sense" experience and knowledge of the manager, foremen and workers on the job?

(3) Shall the standardization work be centralized in a separate department, division or plant bureau (as, for example, in the Allis-Chalmers Manufacturing Company, General Motors Corporation, Fairbanks Morse and Company, Gleason Works, Studebaker Company, Westinghouse Electric, etc.) or shall it be departmentalized (as in the Baltimore and Ohio Railroad, Bell Telephone System, Inter-

[1] The advantages of standardization will be treated in Chap. XI.

[2] John C. Shover, "Standardization in the Textile Industry," *Annals*, *op. cit.*, May, 1928, p. 168.

[3] An examination of the claims that are made for standardization constitutes the subject matter of the entire second part of this study. In this descriptive material now presented, it will not be necessary to go into the economics of standardization, except in a very incidental fashion.

national Harvester Company, Stewart-Warner Speedometer Corporation, Singer Manufacturing Company, etc.)?

(4) Shall standards and standardized processes and procedures be introduced as fast as knowledge of ways, means and properties of materials permits, or shall they be introduced slowly and gradually?

(5) What parts of the plant activity—materials, machinery, product, component parts, processes, procedures—are most readily, easily and advantageously (all factors considered) standardized?

It is impossible to give to any of the above questions a general answer good for all industry. In each industry answers can be given only after careful consideration of a wide variety of important factors, a large part of which, in nearly every case, are peculiar to that particular industry. An examination of the experience of companies formally engaged in the process of standardizing materials and methods may serve to throw some light upon the character of the variable factors involved. The remainder of this chapter will be devoted therefore, first, to a functional description of company standardization, and, second, to a description of the actual standardization experience of some of the larger companies.

Research and Standardization

A bulletin of the American Standards Association[1] declares that "All standardization work ultimately involves a tie with the research laboratory." That is probably an extreme statement. Simplification, or standardization of type, and the standardization of nomenclature,[2] for example,

[1] *Sustaining Members Bulletin*, *op. cit.*, May 10, 1927.

[2] Even nomenclature, however, sometimes becomes a matter for expert determination. For example, what is meant by "hardness?" "Hardness," writes Tuckerman, "in common parlance represents a hazily conceived conglomeration or aggregate of properties of a material, more or less related to each other. These properties include such varied things as resistance to abrasion, resistance to scratching, resistance to cutting, ability to cut other materials, resistance to plastic deformation, high modulus of elasticity, high yield point, high strength, absence of elastic damping, brittleness, lack of ductility and malleability, high melting temperature, magnetic retentivity, etc. This confusion under the one designation "hardness," thus conceived, as a conglomeration of different, more or less unrelated properties makes it impossible to correlate any one definite, measurable property with all the current implications of hardness." L. B. Tuckerman, "Hardness and Hardness Testing," *Mechanical Engineering*, January, 1925, p. 53.

quite frequently require only general agreement of the parties concerned. Particularly is this true of the simplification work of the Federal Division of Simplified Practice. And, of course, all cooperatively established standards involve elements of purely practical compromise.

Nevertheless, with the growth of the complexity of industrial processes, and the more exacting requirements demanded of the finished product, it is becoming increasingly true that decisions relating to changes in materials, products and processes require reference to expert technicians. These technicians, in turn, are becoming more dependent upon the knowledge of the properties of materials, the discoveries of new methods of treatment, new methods of test, and the elaboration of new processes discovered and perfected in laboratories.

Pure scientific research, such as is conducted in the laboratories of the General Electric Company, the Westinghouse Electric and Manufacturing Company and the Bell Telephone System, and in the new laboratory of the United States Steel Corporation, is accompanied by research having to do with the application of new discoveries to the industrial process. As such, research is becoming the principal source of many far-reaching improvements in design, parts and processes. But once the innovation is made, the task of applying the new discovery in mass production becomes a matter of standardization research. Standardization is thus indissolubly linked with research wherever the results of research have come to have practical value in volume production.

The materials and the methods of work in pure research or in standardization research may be highly standardized, or they may be unstandardized and unsystematic. The drawing of specifications, the perfection of methods of test, the task of improving standard processes may, in turn, be standardized or unstandardized. Pure scientific research, standardization research, the drawing of specifications may all be standardized but uncoordinated, or they may be both standardized and coordinated. It is only in the latter case that the greatest value is to be derived from the industrial use of research.

Drawing of Specifications and Testing

Following research in the discovery of the properties of materials and the elaboration of new processes, the first step in the application to the industry is the drawing of specifications for purchase, on the one hand, and for use in processing, on the other.

Thorough standardization requires the purchase on specifications of all commodities, parts, tools, machines, materials, and component parts. The specifications technique is thus not limited to the use of new materials and processes.

Too many variable factors are involved in the drawing of specifications to permit a detailed discussion of the subject here.[1] Broadly speaking, specifications technique involves two processes, and two sets of relationships. The first step is the drawing of the specifications, and the second the testing of goods bought on these specifications. The first set of relationships is internal, concerned with the development and control of the company's production and the use of its scientific and technical information, and the second set external—that is, concerned with the problem of discovering by test whether or not the goods supplied by others meet the purchase specifications.[2]

The original drawing of the specification involves the dual question of the physical and chemical properties of the material and the cooperation with the purchasing department in securing the material. The first is a matter purely of scientific fact, the second is related to the market and to the point of view of the different parties involved.

In the early stages of company standardization the most obvious difference in outlook seems to be between the purchasing agent and the engineer. The engineer in many cases seems to feel that the purchasing agent is unfriendly to his suggestions because of lack of adequate information concerning the properties of the materials needed and the uses to which they are put. The purchasing agent, on the other hand, feels that the engineer makes excessive demands and quite frequently drafts his specifications with the object of

[1] See Appendix A for the properties of a good specification.

[2] *Sustaining Members Bulletin, op. cit.*, May 10, 1927.

"showing off" his technical information.[1] This conflict of point of view emphasizes the necessity for close collaboration between the two. The purchasing agent must buy on the market. Quite frequently a specification will demand special manufacturing, whereas a slight change in the specification would permit the manufacturer to furnish an article he is producing on a quantity basis and hence cheaply. It is frequently worth while, also, to draft the specification so that as many suppliers as possible will bid for the order.

Once the specification has been drawn, the next step is frequently the submission of samples by the prospective suppliers. Tests of the samples offer a basis of selection among the suppliers. Upon delivery of the goods, the engineering staff must go through the process of testing. This is sometimes done on the premises of the supplier, but generally not. Testing and inspection necessarily involve the question of policy concerning rejections of materials failing to meet the specifications. As a general rule, the expense incurred by rejections is borne by the supplier. As standard specifications become more widely used, the importance of sampling, except in case of doubt, tends to diminish very decidedly.

The quantity of goods purchased under specifications generally precludes the testing of every part delivered. Where this is the case, some method of sampling must be adopted. However conscientious the supplier may be, no amount of care and no system of standardization will turn out an absolutely invariable product. Since this is inevitably the case, the problem of testing becomes a problem of keeping variations within definite boundaries, or within the limits of prescribed tolerances of variation. This sometimes calls for the application of very refined statistical techniques. Dr. W. A. Shewart, of the Bell Telephone Laboratories, for example, has worked out what he calls "Quality Control Charts."[2] "A controlled product is defined as one for which frequency of deviations from expected quality can be esti-

[1] Interesting discussions of these issues are to be found in the following: G. A. Thompson, "The Purchasing Agent's Viewpoint," *The Oil and Gas Journal*, Sept. 22, 1927, p. 11; Charles B. Dudley, "The Making of Specifications for Materials," from "The Life and Works of Charles B. Dudley," New York, 1928, pp. 122–142; Gushee and Boffey, *op. cit.*

[2] W. A. Shewart, "Quality Control Charts," *Bell System Technical Journal*, October, 1926.

mated by certain probability theory, provided no assignable causes of variations are present."[1] Variation outside the tolerance limits of a "controlled" product will make possible, according to the theory, the discovery of "assignable causes of variation."

Testing of the finished product requires somewhat the same techniques as are employed in the inspection of materials bought for use in manufacture.

Standardization of Processes and Operation

The standardization of operations and processes of production rests, in the first instance, upon the standardization of equipment. Standardized stationery, letterheads, pencils, filing equipment, requisition blanks, invoices, checks, instruction sheets are the *sine qua non* of standard office practice and production control. Standardized machines with interchangeable parts, and standard tools are of fundamental importance in the shop and factory likewise.

If standard tools and equipment are combined with the proper plant layout, a continuous flow of production from stage to stage and process to process may be made possible. This is one of the most important aspects of the application of standardization technique to production. As maximum efficiency in the machine is dependent upon a given uniform speed and method of operation, with each part intermembered with every other part with the smallest possible coefficient of variation and the minimum of friction, so the efficient operation of an entire plant requires a continuous input of standard goods, a continuous flow from process to process, and a continuous and relatively invariable output. In practice this means reducing stocks to the minimum. Partly finished goods and component parts are never left in the storeroom waiting to be sent through another process at a later date. Inventories reduced to the absolute minimum of goods in actual operation as shown by progress charts becomes the production ideal.

Standardized tools, equipment and processes furnish the basis for standard practices. Standard practices involve the

[1] *Sustaining Members Bulletin*, *op. cit.*, May 22, 1928.

use of safety codes in the handling and use of machinery and equipment, and standard instructions for the proper use and manipulation of materials and equipment to secure desired results. This latter becomes of particular importance as the process of production becomes more complex, and requires the application of scientific principles not known to the scientifically uninitiated. When this stage in the process of standardization has been achieved, the basis has been laid for the application of time and motion principles and the working out of performance standards involved in scientific management.

Standard Product

The degree to which the finished product can be standardized depends upon the management's understanding of market conditions. Market research, on the one hand, and scientific cost-accounting, on the other, are the bases upon which must rest the decision as to the degree to which standardized output can be profitably pushed. The nature of the product sold will sometimes have considerable influence upon the decision made. If the finished product is a simple, relatively undifferentiated product such as paper, wallboard, pencils, etc., the problem of discovering the limits of profitable standardization will be comparatively easy. If, however, the product is a fabricated, "assembled," or "built" one, the decision may not be quite so easily reached.

A large percentage of the machinery manufactured by the Allis-Chalmers Corporation, for example, is produced only to order. But even here, component parts—from screws, bolts, nuts and wire to motor units—can be and have been standardized. The General Electric Company makes electric motors between 10 and 250 horsepower in thirteen ratings, "eight different poles or speeds, both horizontal and vertical, in two forms—squirrel cage and collector ring—for circuits of 60, 50, 40 or 25 cycles and 2,200, 550, 440, 220 or 110 volts, and both three phase and two phase."[1] The sum of these different combinations equals 16,640 motors, many of which are made to stock in standard sizes, and many

[1] John H. Van Deventer, "Extreme Variety versus Standardization, Part VII, Motor Production at the Schenectady Plant," *Industrial Management*, June, 1924, p. 343.

made to special order. "In capacities over 250 horsepower, all motors are made to order, while, below this, certain ratings can be carried in stock, the proportion of stock to special motors varying from about four-to-one in the smaller sizes up to one-to-four at 250 horsepower."[1] Despite this fact, the component parts of these motors, stock and special alike, are 90 per cent standard.[2]

That is to say, even where the final product can not be completely standardized, the component parts can be standardized to a high degree. The nails that go into the most "different" house, the mortar, brick, beams, basic lighting, heating, and ventilating fixtures and equipment, can be standardized. Standardized doors and windows and other ordinary component parts of houses are used in Germany although there is no standardization of the house as a finished unit.[3]

Component parts, or the finished product itself, may be standardized in dimensions, in quality, or in both. Where design standardization is not possible—as, for example, in the women's clothing industry—sizes and the quality and durability of fabrics may be standardized. Fastness of dye, thread twist, weave of the cloth, thread strength, "loading," nomenclature, methods of washing and cleaning and storage can all be standardized in the factory, even though the factory can not standardize style.

The Organization of Company Standardization Work

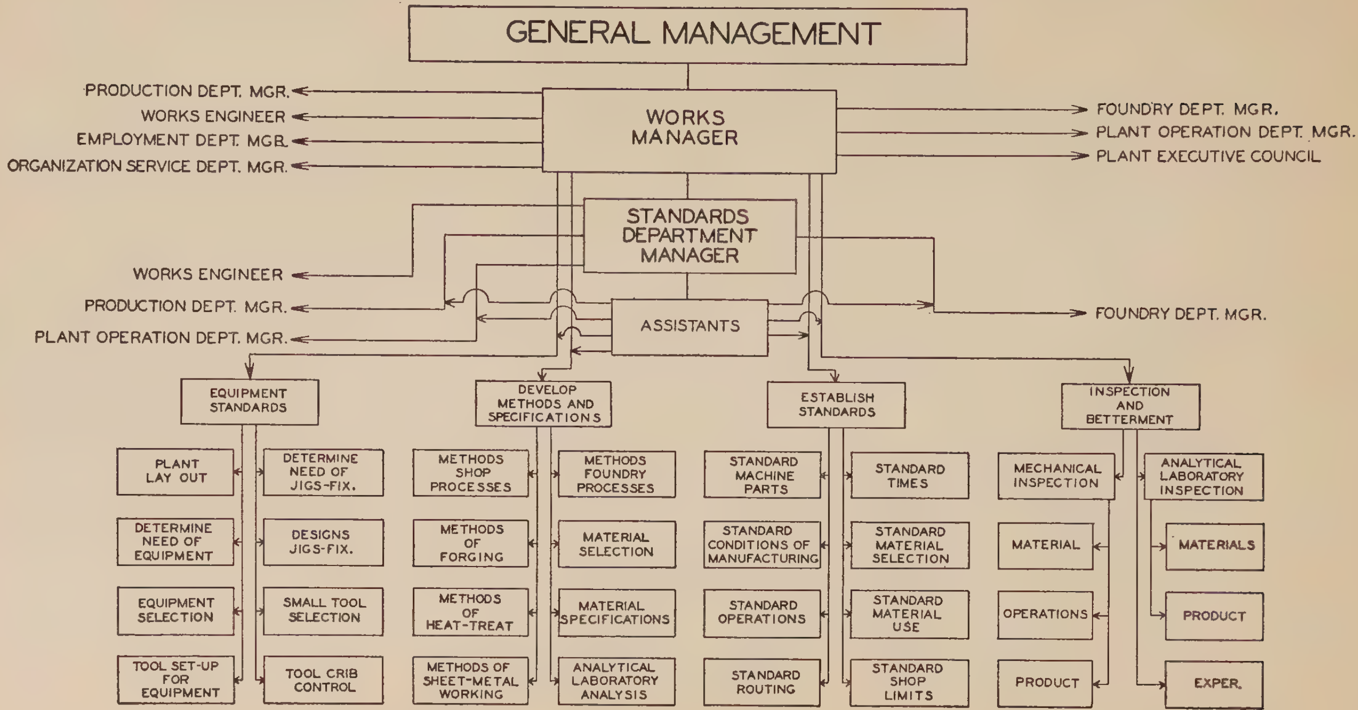
The problem of procedure to be used in promulgating company standards has been met in several ways. In general, the answer will depend upon four factors: (1) the size and number of plants under single management; (2) the variety or the homogeneity of the output; (3) the degree of departmental or plant autonomy with reference to production problems; and (4) the knowledge of the value of standardization as a tool. Where standardization is an accepted company policy, where accepted company policies are highly

[1] *Idem.* [2] *Ibid.*, p. 344.

[3] "DIN 1917–1927," Berlin, 1927, pp. 118–120. This book is a summary of the German standardization movement, put out by the Deutscher Normenausschuss, the central German national standardization body.

Chart 1: Bullard Machine Tool Company, Organization of Standardization Work

(Source: Research Committee of the New England Council. See footnote 1, p. 44)



centralized and where the output is fairly homogeneous, the usual procedure is the establishment of a separate standards department to coordinate the standards of all departments within the company. Standardization work is sometimes highly centralized within departments but quite decentralized with reference to the company as a whole. The following examples will show how standardization problems are handled in typical cases.

Standards Department of the Bullard Machine Tool Company

Chart 1 showing the organization of standardization procedure in the Bullard Machine Tool Company is largely self-explanatory. All standardization work is centralized in a separate Standards Department, under the management of a department head. "New equipment and suggested improvements in method are developed and brought to the operating stage in this department. In fact, this department is a clearing house to anticipate and smooth away difficulties in production. . . . Quality and accuracy of product are functions of the standards department carried out by its inspection division, which, it is to be noted, is independent of the Fabrication Department."[1] Standards adopted require more than a mere consensus of opinion. "The developed methods are adopted as standards only after extensive study of all related conditions."[2]

Central Standards Department of the Werner Plant of Siemens and Halske Works (Berlin)

The organization of the Central Standards Department and the standardization procedure of the Werner Plant of the Siemens and Halske Works are shown in Charts 2 and 3, respectively. These charts are reproduced here because they are said to be fairly typical of German and Continental company standards departments, of which there are now over a thousand in Germany alone.

The "Wernerwerke" produces electrical machinery, and

[1] Research Committee of the New England Council, by the Policyholders' Service Bureau, Metropolitan Life Insurance Company, "The Use of Research in Standardization and Simplification," 1928, p. 11.

[2] *Idem.*

Chart 2: Siemens and Halske Works, Werner Plant, Organization Chart of the Central Standards Department

(Source: *Mechanical Engineering*, January, 1924, pp. 54–55.)

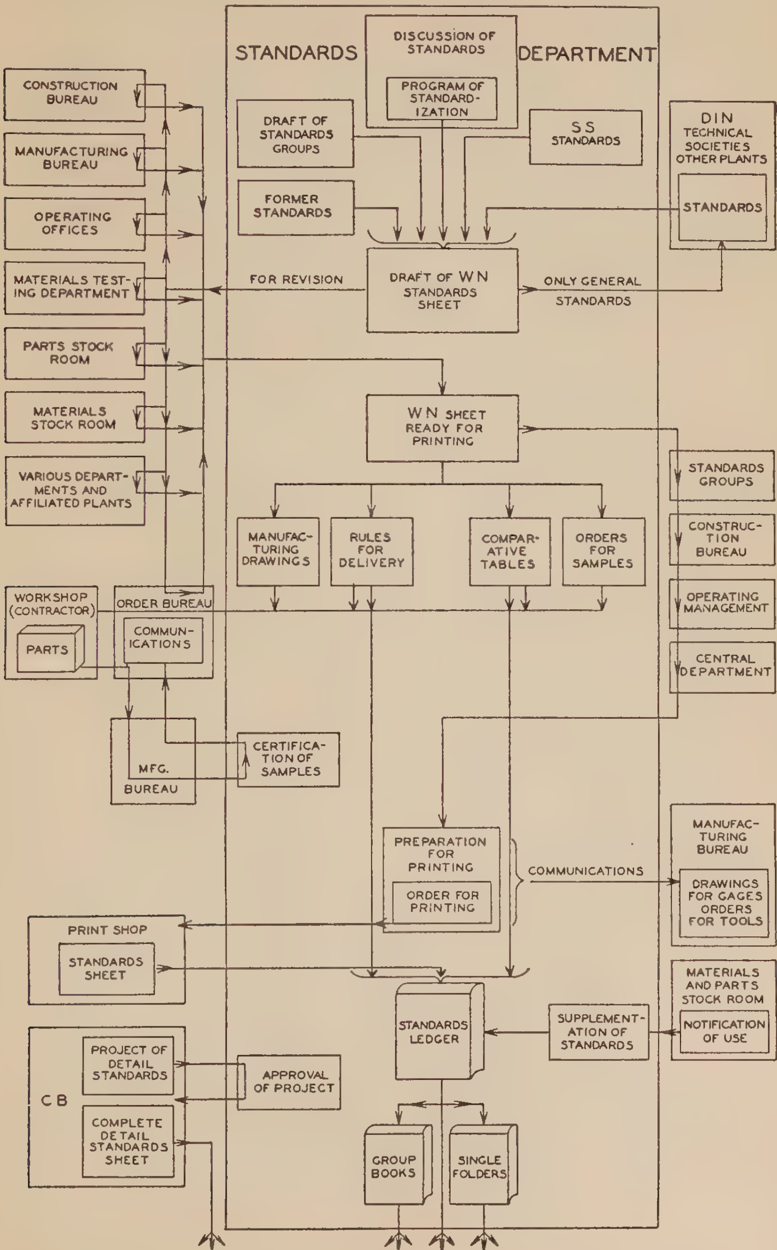


Chart 3: Siemens and Halske Works, Werner Plant, Standardization Procedure

CENTRAL STANDARDS DEPT.
FOLLOWING UP ATTEMPTS AT STANDARDIZATION IN INDUSTRY. THEIR APPLICATION AT THE WERNER PLANT
REPRESENTATION OF THE PLANT'S INTERESTS IN THE TECHNICAL STANDARDS COMMITTEES OF THE ENGINEERING SOCIETIES AND OF THE SIEMENS-SCHUCKERT COMPANY
FIXING DIVISIONS FOR STANDARDIZATION WORK.
BRINGING TOGETHER THE STANDARDIZATION WORK IN THE FACTORY SUPERVISION OF STANDARDS
PREPARATION OF THE PLANT STANDARDS SHEETS.
PREPARATION OF WORKING DRAWINGS FROM STANDARDS SHEETS.
PRINTING AND HOLDING IN READINESS FOR DISTRIBUTION OF STANDARDS SHEETS. DISTRIBUTION OF STANDARDS FOLDERS, REGISTRATION OF RECORDS, STANDARDS SHEETS AND STANDARDS FOLDERS.
SURVEY OF EXECUTION OF WORKS STANDARDS.
BRINGING TOGETHER OF SALABLE STANDARDS PARTS.

STANDARDS SUBDIVISIONS

C.B.F.	PRELIMINARY WORK FOR STANDARDS.
	PREPARATION OF DETAIL STANDARDS.
	CHECKING OF DRAWINGS FOR USE OF STANDARDS.
C.B.M.	CHECKING OF DRAWINGS FOR USE OF STANDARDS.
C.B.W.M.	CHECKING OF DRAWINGS FOR USE OF STANDARDS.
FABO F	SUPERVISION OF MANUFACTURE IN RELATION TO STANDARDS.
	WORKING UP PRODUCTION STANDARDS (FITS, THREADS, ETC.)
	SUPERVISION OF PRODUCTION OF THE W.N. STANDARD PARTS. PREPARATION OF TOOLS AND RULES FOR STANDARD PARTS.
	PREPARATION OF THE W.N. MATERIALS AND HALF-FINISHED PRODUCTS STANDARDS. RULES FOR DELIVERY AND MATERIALS.
	INSPECTION OF ORDERS FOR ABNORMAL HALF-FINISHED MATERIALS.
FABO M	SUPERVISION OF PRODUCTION IN REGARD TO STANDARDS.
CENTRAL TOOL DIVISION	PREPARATION OF STANDARD TOOLS. STOCK ROOM FOR STANDARD TOOLS AND THEIR DISTRIBUTION.
ORDERS DIVISION	ORDERS FOR STANDARDS AND SUPERVISION OF LIMITS.
PARTS STOCK ROOM F	RECEIVING STANDARD PARTS.
	STOCK AND DISTRIBUTION.
RAW MATERIALS STOCK ROOM F	RECEIVING, STOCKING AND DISTRIBUTION OF STANDARD HALF-FINISHED PRODUCTS.
BUREAU F	CALCULATION OF STANDARD PARTS.
SALES DEPT. F	SALE OF STANDARD PARTS.
CONSTRUCTION AND MANAGEMENT BUREAU	PREPARATION FOR STANDARDS. CONSTRUCTION STANDARDS. WORKSHOP INSTALLATION. BUREAU ARRANGEMENT.
UTILIZATION OF MATERIALS F	PRELIMINARY WORK FOR STANDARDS. BUREAU REQUIREMENTS.

at the time these charts were drawn, in 1924, was employing 18,000 men. A highly centralized standards procedure exists.

> "The Standards Department has definite relationships with every department and bureau of the entire plant, with the DIN, and with the technical societies. Apparently a complete system exists for the receipt and acceptance of DIN Standards, for their modification and revision when necessary, for their printing in Siemens and Halske form, for their incorporation in the general work of the factory, for their definite filing in folders, ledgers, and standard books, and for their distribution to various departments and bureaus of the factory. The charts also indicate that a system is just as carefully worked out for the preparation of standards by the Standards Department of the factory itself. Provision is made for the initiation and criticism of proposals by other departments, and for the cooperation of all departments in the general work of standardization."[1]

Standards accepted or promulgated by the Central Standards Department are sent out to the different departments within the company as Standards Sheets.

> "Great care is shown in the preparation of standards sheets, definite rules have been drawn up to cover the manner in which DIN sheets are prepared for international circularization, the marking and indexing of the sheets, and the preparation of drawings both for showing standard dimensions and for actual factory production work."[2]

A classification of standards sheets has been worked out, within which all standards fall as they are developed from time to time to meet current needs. It is sufficiently interesting to be worth reproducing, as follows:

Standards Sheets—Index for Groups and Classes

(0) *General Rules—Business Routine*
(00) General correspondence
(01) Standardization
(02) Business routine and communication
(03) Drawings
(04) Drawings
(05) Rules for delivery of raw materials
(06) Rules for delivery of parts
(07) Bureau and shop organization
(08) Business papers, books, cards
(09) Miscellaneous

(1) *Manufacturing Rules*
(10) Handling of the surface of metals
(11) Finishing and fitting
(12) Working materials hot
(13) Coating
(14) Working of insulated materials
(15) Rules for winding
(16) Connections
(17) Rules for assembly
(18) Test and acceptance rules
(19) Miscellaneous

[1] "An Example of Standardization in German Industry," *Mechanical Engineering*, January, 1924, pp. 54–55. The expression DIN refers to standards promulgated by the German Standards Association, Deutscher Normenausschuss. See Chapter VI of this volume.

[2] *Idem.*

Standards Sheets—Index for Groups and Classes—(Continued)

(2) *Calculations*

(20)
(21)
(22)
(23)
(24)
(25)
(26) Tools
(27)
(28)
(29)

(3) *Basic Standards*

(30) Measurements and number series
(31) Mechanical Construction
(32) Electrical construction
(33)
(34)
(35) Tools
(36)
(37)
(38) Marks, names, abbreviations
(39) Miscellaneous

(4) *Materials*

(40) Iron
(41) Iron
(42) Steel and alloyed steels
(43) Brass, bronze, red brass, copper
(44) Brass, bronze, red brass, copper
(45) Aluminum, german silver
(46) Various metals
(47) Insulating materials, textiles, wood
(48) Lacquer, oils, rosin, wax
(49) Miscellaneous

(5) *Half-Finished Products*

(50) Iron
(51) Iron
(52) Steel and alloyed steels
(53) Brass, bronze, red brass, copper
(54) Brass, bronze, red brass, copper
(55) Aluminum, german silver
(56) Various metals
(57) Insulating materials, textiles, wood
(58)
(59) Miscellaneous

(6) *Construction Standards—Mechanical Requirements*

(60) Screws
(61) Screws and screw connections
(62) Nuts and pulleys
(63) Fastening and transmission elements
(64) Fastening and transmission elements
(65) Service elements
(66) Scales, plates, studs, armatures
(67)
(68) Springs and spring parts
(69) Miscellaneous

(7) *Construction Standards—Electrical Requirements*

(70) Connection and distribution elements
(71) Connection and distribution elements
(72) Contacts, switches, etc.
(73) Insulated service elements
(74) Resistances
(75) Magnets and electromagnets
(76) Hard rubber, porcelain, stealite parts
(77) Coils and coil cores
(78) Conductors, cables and fixtures
(79) Miscellaneous

(8) *Tools and Gages*

(80) Hand tools
(81) Boring, drilling, grinding tools
(82) Milling tools
(83) Cutting, molding, drawing tools
(84) Turning, planing, and punching tools
(85) Lathes and fixtures
(86) Auxiliary tools
(87)
(88) Rubbing and polishing tools
(89) Miscellaneous

(9) *Miscellaneous*

(90) Detail standards
(91) Standards of other plants
(92) Standards of foreign societies
(93) DIN general
(94)
(95)
(96)
(97)
(98)
(99) General

The Promulgation of Detroit Edison Standards[1]

The standardization work of the Detroit Edison Company, as shown in Chart 4, is centralized in the Main Committee

[1] From data furnished by the Detroit Edison Company.

" . . . consisting of the Chief Engineer, General Storekeeper and Purchasing Agent." This Main Committee, it will be observed, occupies a position similar to that of standards departments in other companies. The process of establishing standards is delegated to sub-committees, representative of the different interested departments within the company. Upon selection of the standardization project, the sub-committee is formed. The company now has fourteen sub-committees functioning on projects as follows:

(1) Piping and Fittings
(2) Cable and Conduits
(3) Building Material
(4) Classification
(5) Packing and Gaskets
(6) Tools and Tool Steel
(7) Carbon Brushes
(8) Relays, Insulators and Insulation
(9) Firebrick
(10) Stoker Castings
(11) Chemicals and Proprietary Chemical Products
(12) Bolts, Nuts, Screws, Nails, etc.
(13) Standards Catalog Publishing Committee
(14) Lamps.

Upon completion of the final report of the subcommittee, "the Main Committee meets to consider its adoption as a tentative Detroit Edison Standard. In approving the reports the members are governed by the usual general policy of such a body, i. e., that in appointing the subcommittee the men most competent to form the standard were chosen and it therefore remains to make simply a cursory check to detect any violations of general company policy." Standards completed are to be printed and sent to "departments which are interested in a particular class of material." Eventually, all standards are to be combined into a general catalog.

The Detroit Edison Company cooperates in its standardization work with the American Standards Association, the American Society for Testing Materials, and with other groups having standards of value to their industry. Although the Main Committee has been in existence only since early in 1927, it has made a very creditable showing, as the following estimate of the status of standardization indicates:

(1) Total number of items being purchased by the Detroit Edison Company	46,000	
(2) Total number of items under consideration of standardization committees	28,000	(61%)
(3) Number of items where standardization will be impracticable	5,000	(11%)
(4) Number of items left to be assigned to standardization committees	13,000	(28%)
(5) Total number of items subject to standardization	41,000	(89%)

Chart 4: Detroit Edison Company, How a Detroit Edison Standard is Formed

(Source: Detroit Edison Company)

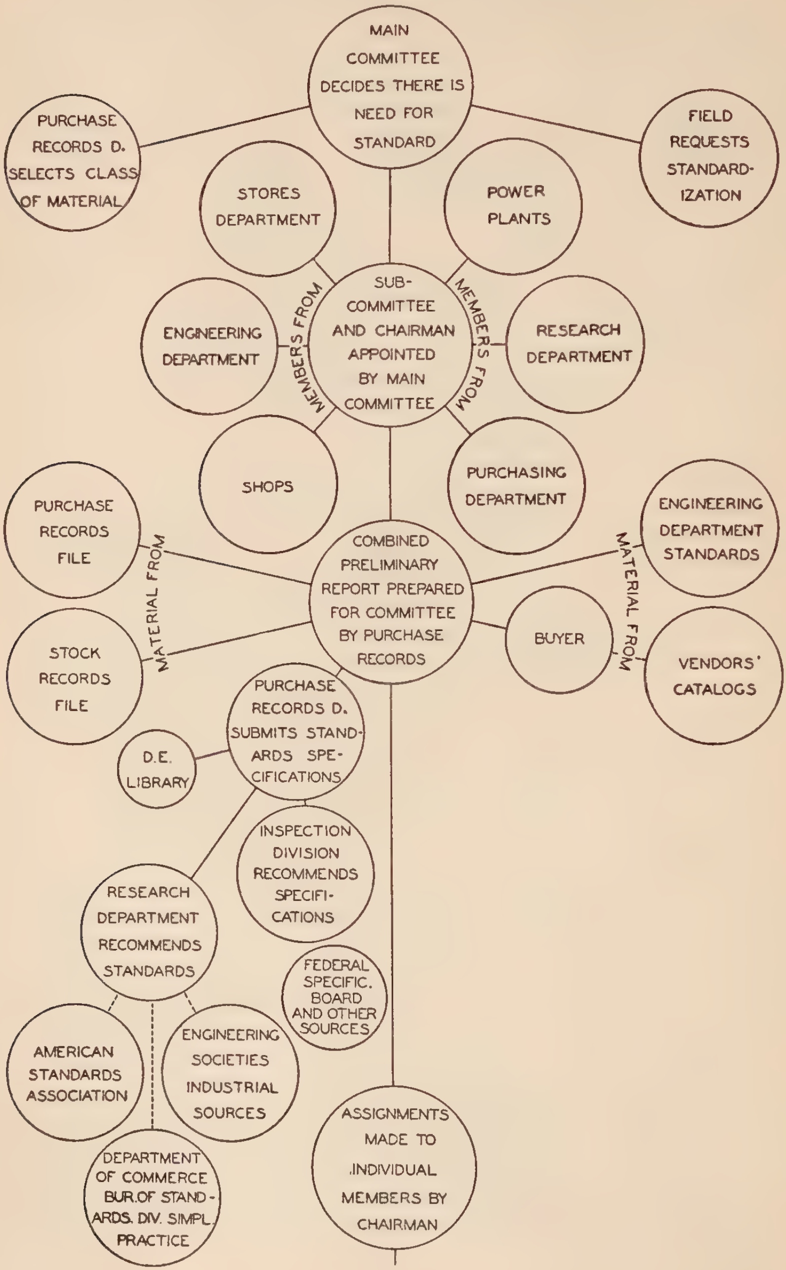
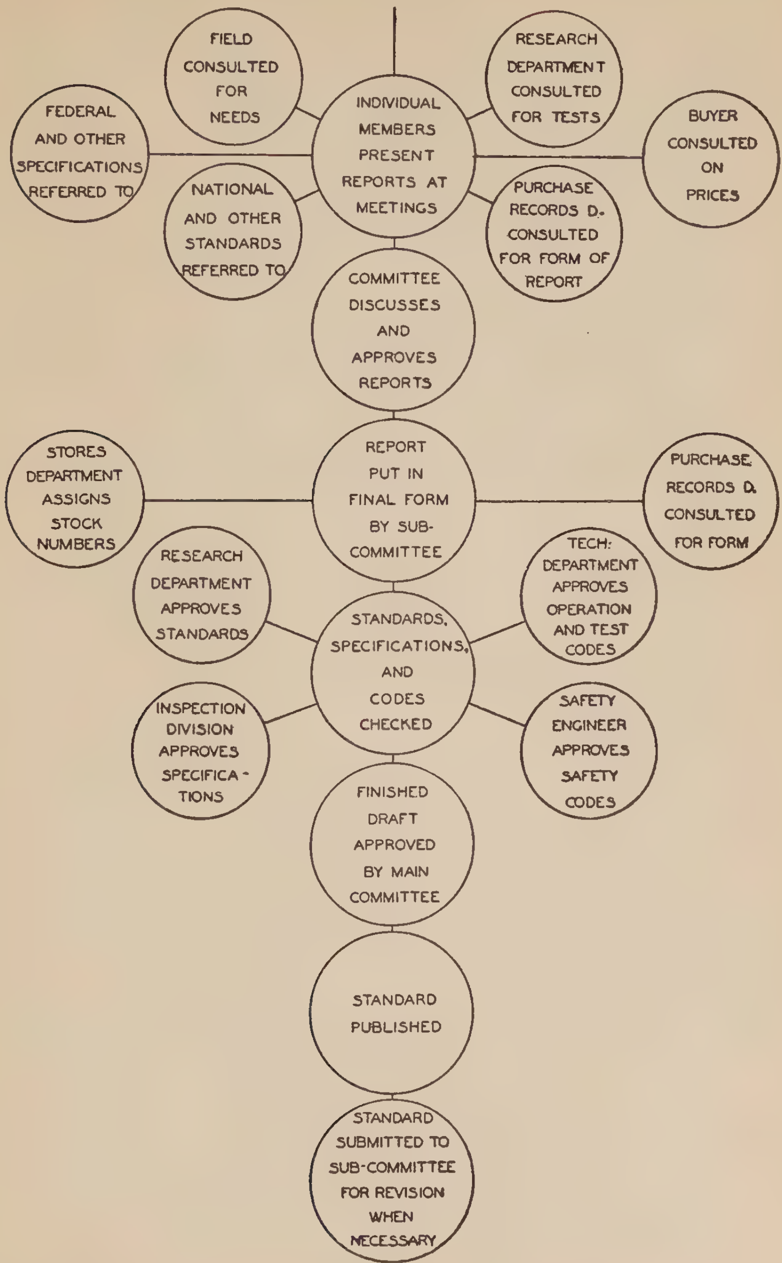


Chart 4: Detroit Edison Company, How a Detroit Edison Standard is Formed—(*Continued*)



(6) Items under consideration are 60% completed.
(7) Total standardization is 40% completed.
(8) Man-hours expended in sub-committee meetings (estimate) 1,750
(9) Man-hours necessary for complete standardization (estimate) 5,000
(10) Man-hours expended outside of committee room approximately equivalent to time spent in committee room (estimate) 5,000
(11) Total man-hours required for complete standardization job (estimate) 10,000

Standardization in the Westinghouse Electric and Manufacturing Company[1]

The standardization activities of the Westinghouse Electric and Manufacturing Company are somewhat less centralized than those of the companies reviewed above, as Chart 5 shows. However, the Standards Committee, organized on a departmental base, is steadily growing in importance. The functions of this department are enumerated as follows:

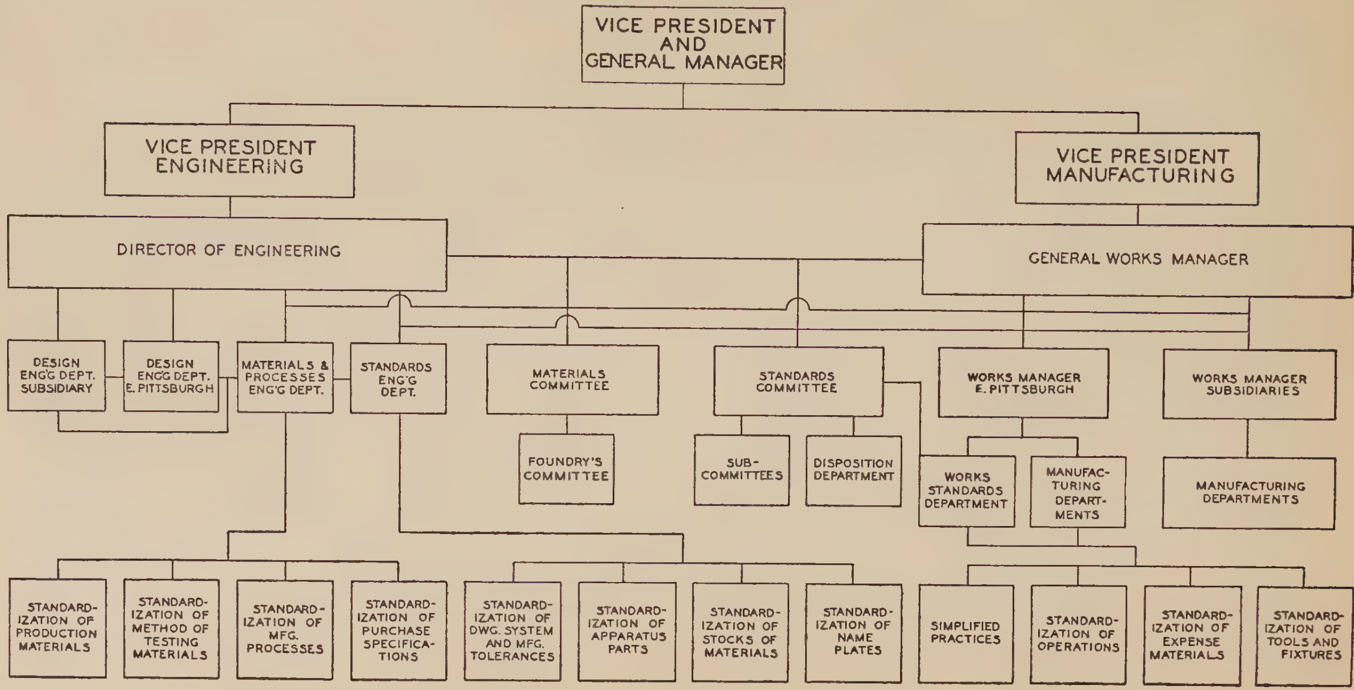
(1) Standardization of materials that are used in the building of apparatus.
(2) Standardization of parts and accessories.
(3) Rules for design of standard apparatus.
(4) Records of parts of machines, special stress being laid on those for which pattern dies or tools are available, including list of tabulated drawings suitable for additions.
(5) Preparation of drawings for accessories which are of general use throughout the Works.
(6) Issue of data useful to engineers engaged in Mechanical and Electrical Design, such as standardized symbols and abbreviations, mathematical tables and results of research work, recognized design practices and method of figuring.
(7) Standardization of literature for publicity purposes, preparation of slides for lectures, of illustrations for papers.

Wherever standards affect only one department, or wherever interdepartmental interests make it possible, the Standards Committee is not called in. But, "When an investigation requires a series of consultations, especially when the desired results meet with wide-spread interest, such meetings are arranged under the sponsorship of a Standards Committee . . . . This Committee consists generally of not more than seven members, selected by the management from those best acquainted with the particular phase of the work under consideration, without attempting to interfere with

[1] The data for the writing of this section have been supplied by the Westinghouse Electric and Manufacturing Company.

CHART 5: WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY, ORGANIZATION OF STANDARDIZATION WORK

(Source: Westinghouse Electric and Manufacturing Company)



their regular duties." Decisions made are submitted to the management for approval, following which standards are published in the Standards Book, consisting now of about 450 pages and distributed throughout the different departments of the plant in approximately 500 copies, each book containing only such data as are likely to be useful to that department. Changes in old standards, and additional standards are brought to the attention of the different departments by a monthly news bulletin.

In the process of developing standards, the company cooperates with the American Standards Association, engineering and technical societies, trade associations, interested departments of the Federal Government, and the leading manufacturers of supplies. Suggestions may come from any individual within the company, regardless of class or status.

All materials and sizes are classified with reference to their desirability as present and future standards. The classes, together with their definitions, are as follows:

> "A"—Standard carried in stock. Material to be used on new designs. Material and sizes conform to commercial standards or a preferred standard, usually purchased on the open market.
>
> "B"—Carried in stock for old design or for specific application after approval. Materials and sizes that are undesirable, both in size and as a commercial product, are placed in this class, and limited to this particular application; thus their use is limited and will eventually die.
>
> "C"—To be ordered for specific application or for specific orders for old designs after first checking with engineer for possible substitutes. Will not be carried in stock but may be ordered without approval form.
>
> "BC"—Stock on hand to be used. Not to be ordered for stock. Will become class "C" when present stock is exhausted.
>
> "D"—Superseded by another size—never to be reordered.
>
> "BD"—Size to be superseded by another size when present stock is exhausted. Never to be reordered.
>
> "E"—Form 4,504. Can not be ordered without approval form for each order. Not to be carried in stock.

The scope of the standardization work of the company is very great. The following subject index of the Standards Book on general design features will offer an insight into the extent of this work in a particular field, that of design of standard apparatus:

General Instructions
- Abbreviations
- Lettering
- Drawing System
- Definitions
- Mathematical Tables

Shop Practice
- Allowances and Tolerances
- Process Finishes

Design
- Keys
- Shafts and Spider Parts
- Transmission Data

- Commutators
- Collectors
- Punchings
- Finger and Vent Plates
- Endplates
- Coils and Connections
- Brushholder Brackets
- Bearings and Pedestals
- Frames
- Bedplates and Foundation
- Transformers
- Switchboard Apparatus

- Control Apparatus
- Supply Apparatus
- Springs

- Nameplates

Materials
- Hardware
- Steel
- Alloy

- Copper
- Brass
- Wood

- Paper
- Cloth
- Insulating Material
- Tubing

The above arrangement covers production materials. A Works Standards Department has been organized and has arranged a similar plan for expense materials.

Standardization in the Bell Telephone System[1]

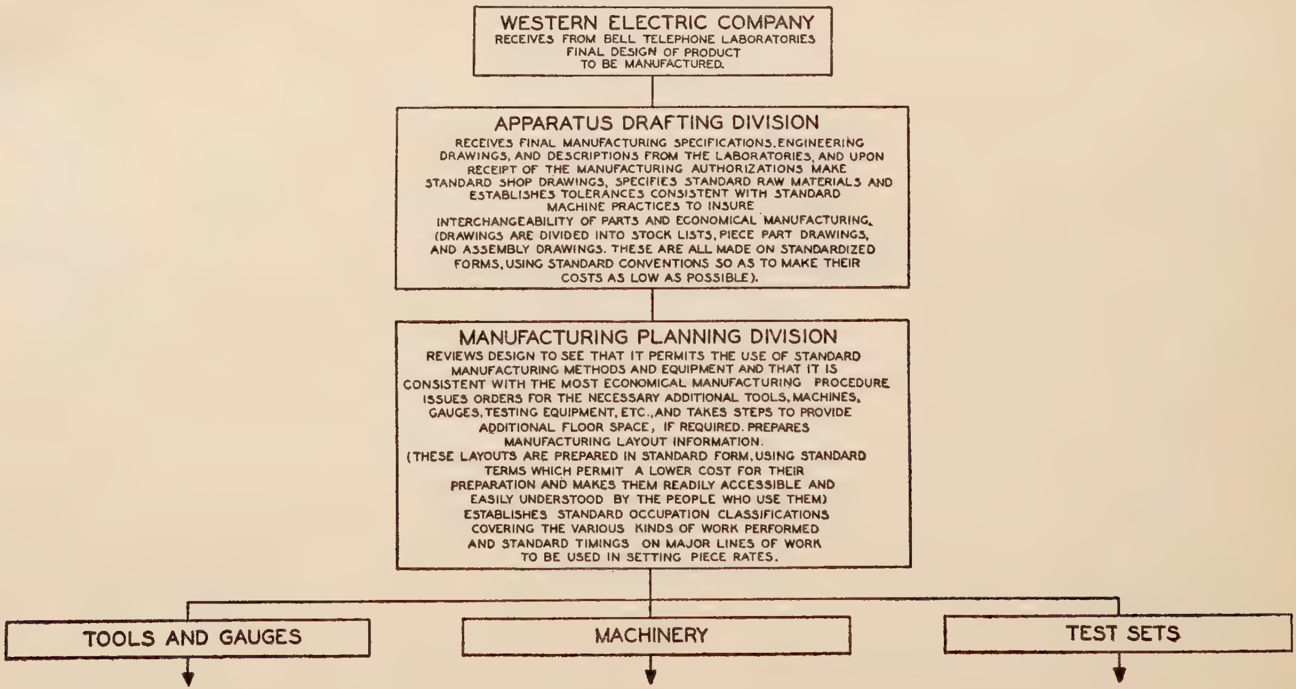
Standardization in the Bell System is highly functionalized on a departmental, intra-departmental or company basis. The headquarters' forces, consisting of the general departments of the American Telephone and Telegraph Company and the Bell Telephone Laboratories, are devoted to working out and standardizing improvements in telephone plant, methods, and operating practices in the entire field of telephone work. This includes fundamental research work; the development, design and specification of apparatus and of systems of communication; the development of standard methods of test; construction and maintenance practices; methods of handling telephone traffic; business methods; and provisions for safety and health.

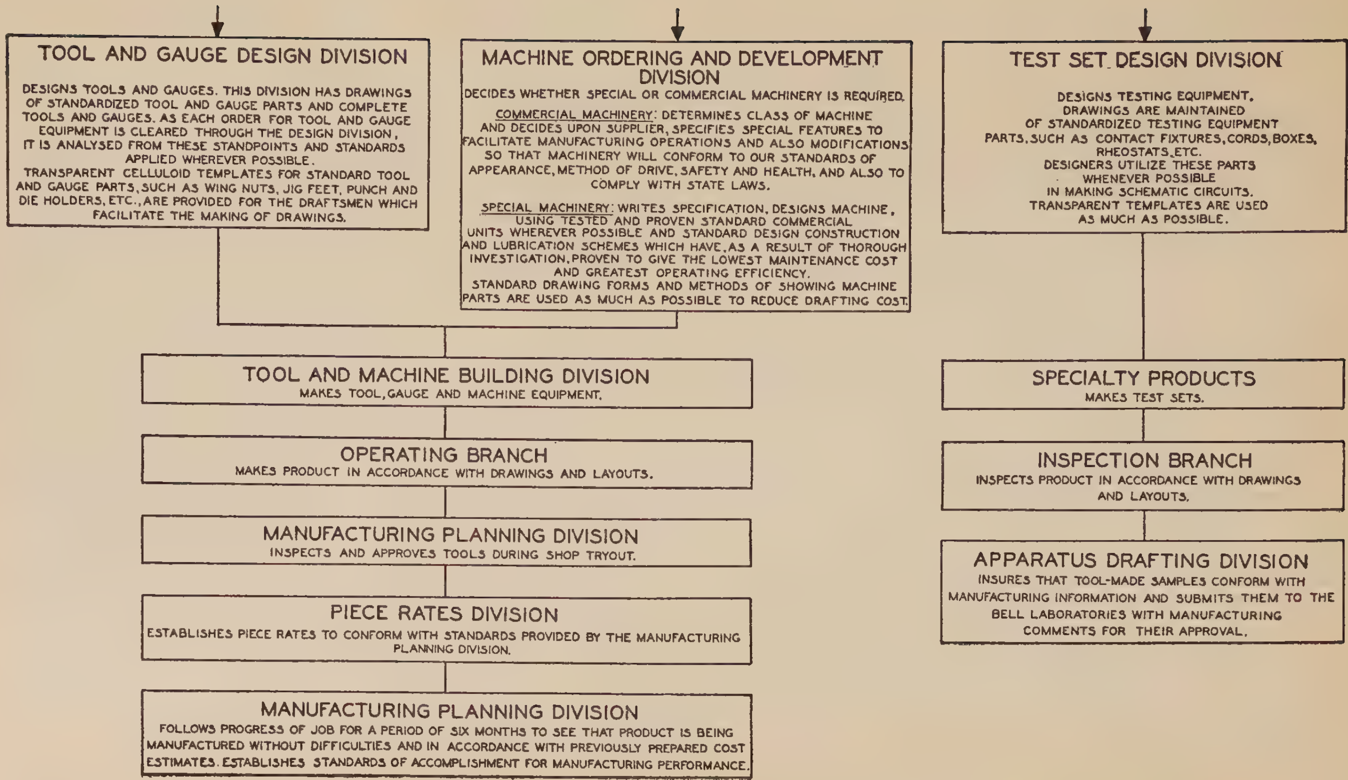
The Western Electric Company, which is the manufacturing, purchasing, stock-keeping, distributing and installing branch of the organization, is, of course, very much concerned with standardization. A great deal of its manufac-

[1] From data furnished by the Bell Telephone System.

Chart 6: Western Electric Company, Development of Manufacturing Standards

(Source: Bell Telephone System)




TOOL AND GAUGE DESIGN DIVISION
DESIGNS TOOLS AND GAUGES. THIS DIVISION HAS DRAWINGS OF STANDARDIZED TOOL AND GAUGE PARTS AND COMPLETE TOOLS AND GAUGES. AS EACH ORDER FOR TOOL AND GAUGE EQUIPMENT IS CLEARED THROUGH THE DESIGN DIVISION, IT IS ANALYSED FROM THESE STANDPOINTS AND STANDARDS APPLIED WHEREVER POSSIBLE.
TRANSPARENT CELLULOID TEMPLATES FOR STANDARD TOOL AND GAUGE PARTS, SUCH AS WING NUTS, JIG FEET, PUNCH AND DIE HOLDERS, ETC., ARE PROVIDED FOR THE DRAFTSMEN WHICH FACILITATE THE MAKING OF DRAWINGS.
MACHINE ORDERING AND DEVELOPMENT DIVISION
DECIDES WHETHER SPECIAL OR COMMERCIAL MACHINERY IS REQUIRED.
COMMERCIAL MACHINERY: DETERMINES CLASS OF MACHINE AND DECIDES UPON SUPPLIER, SPECIFIES SPECIAL FEATURES TO FACILITATE MANUFACTURING OPERATIONS AND ALSO MODIFICATIONS SO THAT MACHINERY WILL CONFORM TO OUR STANDARDS OF APPEARANCE, METHOD OF DRIVE, SAFETY AND HEALTH, AND ALSO TO COMPLY WITH STATE LAWS.
SPECIAL MACHINERY: WRITES SPECIFICATION, DESIGNS MACHINE, USING TESTED AND PROVEN STANDARD COMMERCIAL UNITS WHEREVER POSSIBLE AND STANDARD DESIGN CONSTRUCTION AND LUBRICATION SCHEMES WHICH HAVE, AS A RESULT OF THOROUGH INVESTIGATION, PROVEN TO GIVE THE LOWEST MAINTENANCE COST AND GREATEST OPERATING EFFICIENCY.
STANDARD DRAWING FORMS AND METHODS OF SHOWING MACHINE PARTS ARE USED AS MUCH AS POSSIBLE TO REDUCE DRAFTING COST.
TEST SET DESIGN DIVISION
DESIGNS TESTING EQUIPMENT. DRAWINGS ARE MAINTAINED OF STANDARDIZED TESTING EQUIPMENT PARTS, SUCH AS CONTACT FIXTURES, CORDS, BOXES, RHEOSTATS, ETC. DESIGNERS UTILIZE THESE PARTS WHENEVER POSSIBLE IN MAKING SCHEMATIC CIRCUITS. TRANSPARENT TEMPLATES ARE USED AS MUCH AS POSSIBLE.
TOOL AND MACHINE BUILDING DIVISION
MAKES TOOL, GAUGE AND MACHINE EQUIPMENT.
OPERATING BRANCH
MAKES PRODUCT IN ACCORDANCE WITH DRAWINGS AND LAYOUTS.
MANUFACTURING PLANNING DIVISION
INSPECTS AND APPROVES TOOLS DURING SHOP TRYOUT.
PIECE RATES DIVISION
ESTABLISHES PIECE RATES TO CONFORM WITH STANDARDS PROVIDED BY THE MANUFACTURING PLANNING DIVISION.
MANUFACTURING PLANNING DIVISION
FOLLOWS PROGRESS OF JOB FOR A PERIOD OF SIX MONTHS TO SEE THAT PRODUCT IS BEING MANUFACTURED WITHOUT DIFFICULTIES AND IN ACCORDANCE WITH PREVIOUSLY PREPARED COST ESTIMATES. ESTABLISHES STANDARDS OF ACCOMPLISHMENT FOR MANUFACTURING PERFORMANCE.
SPECIALTY PRODUCTS
MAKES TEST SETS.
INSPECTION BRANCH
INSPECTS PRODUCT IN ACCORDANCE WITH DRAWINGS AND LAYOUTS.
APPARATUS DRAFTING DIVISION
INSURES THAT TOOL-MADE SAMPLES CONFORM WITH MANUFACTURING INFORMATION AND SUBMITS THEM TO THE BELL LABORATORIES WITH MANUFACTURING COMMENTS FOR THEIR APPROVAL.

turing work consists in the quantity production of standardized products, which facilitates the use of standardized manufacturing processes. In the distribution of apparatus and materials and in the installation of telephone equipment, standardized methods have been more highly developed and successfully followed than in any other American industry.

The telephone system throughout the country is operated by a group of twenty-four associated operating companies. Through the close cooperation between these companies and the headquarters' forces, full advantage is taken of field experience in the determination and standardization of the best methods and practices as regards the quality of the telephone service, including the construction and operation of plant, business methods, and provisions for safety and for the health of employees.

To a large extent the standardizing work of the Bell System deals with matters peculiar to its own problems and is carried on within the system itself. The various parts of the Bell System are, however, taking very active part in cooperation with numerous national organizations in the development of standards which have a broader application than within the Bell System itself.

Chart 6 gives an excellent picture of the method by which standards are set up in the Western Electric Company. The chart shows clearly the extremely thorough and scientific character of the standardization work. In the work of no other company that has come to our notice, at least in the United States, have standards been so completely and intimately linked with fundamental scientific research.

Standardization in Companies of Different Sizes

Although highly centralized standardization work is found mainly in the larger companies, organized and systematic standards programs are to be found in practically every scale of industrial operations. The Dexter Folder Manufacturing Company, the Gleason Works (machine tools and machine parts), the General Motors Corporation and the Ford Motor Company are large firms having highly organized standards work similar to that of the companies analyzed above.

These companies differ widely in size and in the scale of business operations.

The Cronk and Carrier Manufacturing Company, manufacturers of iron and steel hardware goods, pliers, pruning shears, garden sets, snow shovels, tools, hedge shears, trowels and haying tools, divides its standardization work into "(a) standardization of material, (b) of operations, and (c) of tools."[1] In standardizing materials they "fix its name, its weight and measure, its cost and its quantity." This is supplemented by a careful and comprehensive system of materials classification into "product, product stores, general stores and worked material." This involves the standardization of dimensions standardization, for the purpose of securing interchangeability of parts, standardization of units (pounds, pieces, feet, tons, barrels, gallons, gross, etc.), standardization of material cost based upon a system of cost accounting, and the standardization of material quantity (by determining minimum quantities of stocks and inventories to be kept at hand).

A large number of comparatively small firms have taken up standardization in some form or other. Those that have tried standardization of type, or simplification, are legion, as the records of the American Standards Association and the Division of Simplified Practice show.

Company Standardization in Foreign Countries

A brief outline of the standards department of one German company has been given above. There were in 1924 over a thousand German firms and about twelve Czechoslovakian firms having such standards departments. Some of these company standards departments, or "Standards Bureaus" (Normalienbureaus) as they are customarily called, have permanent staffs of three or more persons devoting full time to the work. Some firms have branch bureaus in separate departments or separate factories. "One of the well known companies has twenty-one such branch bureaus, employing in all a special staff of more than one hundred who give full time to standardization activities. Another one of the great

[1] F. A. Schmidt, "Standardization at Cronk and Carrier Manufacturing Company, Canton, Ohio," *Annals*, *op. cit.*, May, 1928, pp. 121–137.

firms has a permanent full-time staff of over two hundred in its various branch bureaus."[1]

Standardization projects may be proposed from any responsible source within the company. Generally, however, "the standard bureau staff prepares definite proposals as a first step in the agreement on a standard. This is then used as a target for discussion at the official committee meetings at which all interested departments are formally represented. The bureau does all editorial and secretarial work in connection with the various meetings necessary to bring about and to make effective the actual standardization work."[2]

Since the foundation of the Deutscher Normenausschuss as a central body for the development of German national standards, private companies have cooperated very closely with trade associations and technical societies. Company standardization is, in fact, one of the most important steps in Germany in the development of national standards. A great many of the standards adopted by private companies are DIN standards.

Whether the standards used by a company are its own, DIN standards, or DIN standards adapted to its own particular needs, they are circularized to all departments in the form of standard sheets. One large company arranges to have about 800 copies of each DIN standard, regardless of its character, delivered to its office as a matter of routine.[3]

The heads of the standards bureaus in Germany usually report directly to the general manager. There seems to be considerable variation in the amount of authority delegated, but in some cases only the management can overrule the decisions of the bureaus. In practically all cases "special parts or materials outside of the regular standards must be authorized by a special administrative order."[4]

[1] *Sustaining Members Bulletin, op. cit.*, Dec. 6, 1923. [2] *Idem.*

[3] *Idem.*, "The Normenausschuss now averages a sale of 100,000 sheets of standards a month. This alone, however, does not give an adequate idea of the extent to which the national standards are being utilized in industry, since the special industry committees or trade associations and the larger of the companies publish much of the same material in large numbers in a form best suited to their own needs. One of the large firms . . . publishes as a minimum 800 copies of each standard, and keeps up to date 800 sets in the various plants, shops and departments so that they may be easily and readily consulted by all who have need of them. Even specifications are published in the loose-leaf standard sheet form for the use of shops and drafting rooms." [4] *Idem.*

CHAPTER IV

STANDARDIZATION WORK OF ENGINEERING AND OTHER TECHNICAL SOCIETIES

ENGINEERING is as old as the history of human material achievement, but the term engineer is of somewhat more recent origin. First used in a very restricted sense to designate men who designed and supervised the construction of materials and structures of military value, it has gradually been broadened to apply to any person who controlled (in the physical sense), or contrived to "put through" some project having to do with the mechanical or chemical design, construction, or manipulation of materials, tools, machines, or men (management engineer).[1]

The use of the term leaves the field very broad in one sense, but very definitely circumscribes it in another. The engineer, and engineering in general, is limited to the material, the mechanical, the physical in activity. As an engineer, one does not discuss the social sciences, draw codes of ethics, morality, or good conduct, discourse on æsthetic values or introduce legislative measures. Anything that relates directly to the clarification or simplification of terminology; the classification of physical properties of materials; the determination of dimensional or quality (physical) interrelationships; the design, building, manipulating of tools and machinery or the codification of recommendations or rules of procedure in the handling of industrial equipment, falls within the sphere of the engineer's activity. This distinction is important, for at present there is considerable discussion as to just what is an "engineering problem."[2]

[1] Charles B. Dudley, *op. cit.*, p. 162.

[2] This question has been involved in a recent American Standards Association project on sheeting. It seems to be accepted that weight, thread count, thread twist, sizing, loading and nomenclature are engineering problems, but that considerations of desirability resting on idiosyncrasies of taste are not. See, American Engineering Standards Committee, *Minutes of the Conference on Sheets and Sheeting*, May 25, 1928.

Dictionary definitions and accepted usage are fairly clear on this differentiation. If the engineer attempts to legislate or to draft a law for legislative action, he is acting in a judicial or a political capacity, not an engineering one; if he engages in eulogizing or denouncing the moral or æsthetic value of engineering achievements, he is speaking not as an engineer but as a moral exhorter.

Unfortunately, it is not possible to state the meaning of the term "engineering society" as clearly as that of the term "engineer." Strictly speaking, an engineering society would devote itself to the carrying out of strictly engineering projects. As such, one would expect the following more or less "ideal" attributes to characterize an engineering society:

(1) Membership would be on a personal and professional, rather than on a corporate or trade association basis. The members would all be engineers.

(2) The objects of the society would be: scientific research for the purpose of discovering new properties of materials, new ways and means of further adaptation, improvement and refinement of known principles and materials to the processes of production, clarification of terminology, classification of materials, etc. Monetary return would not be an object except in so far as it might result from clearer and wider knowledge of techniques.

(3) It would concern itself with material standards, and not with moral, æsthetic, "social" standards. Legislation would lie outside its field. Its "codes" would consist of codifications of "best practice"—recognizable as such by practical and theoretical experts—of knowledge, of classification of terms, etc.

(4) It would not be concerned with the personal equation, such as is encountered in the work of the Society of Industrial Engineers[1] and other organizations carrying forward the principles of "scientific management." The line of demarcation is not clear here. But in general, it can be drawn at that point where practices

[1] See the description of this society's work in the "Standards Yearbook, 1928," *op. cit.*, p. 344.

that do not relate directly to technical details concerning the handling of chemicals, tools and machinery are devised with the object of securing safety to the operative, efficiency from the machine and the desired or "correct" result from the process.

The actual existing engineering societies do not conform to all these characteristics. In membership they vary from the purely personal basis such as is found in the Society of Automotive Engineers (S. A. E.), the American Society of Mechanical Engineers (A. S. M. E.), and the American Institute of Electrical Engineers (A. I. E. E.), to the opposite extreme where membership includes individuals, corporations, trade associations, schools, etc., as does the American Society for Testing Materials (A. S. T. M.).

Where membership is not on a purely professional basis, considerations of corporate interest obtrude into the deliberations of the society. This is particularly true where the society is more or less the adjunct of a trade association, as is the case with the American Railway Engineering Association (A. R. E. A.). Practically all of the engineering societies are in close touch with, or generally reflect, the corporate and trade association point of view, either through dual relationships of their memberships or through joint sponsorship on some American Standards Association project.

The third point outlined above is of importance because of the many disputes that have arisen about the meaning of the term "code." There is nothing in the dictionary definition or in common usage to make the term "code" imply mandatory regulation backed by the threat of punitive measures. A "code of honor," a "code of best practice" or a "safety code" is in the same class with a legislative code, in that it is systematized and coordinated; it is different in the sense that only legislative codes are backed by the threat of legal coercion. The fact that engineers are human beings and quite frequently express sentiments regarding "the good, the beautiful, and the true" does not alter the fact that in such moments they are speaking as men and not as engineers "ex officio."

The fourth point, concerning personal relations, has been dealt with in Chapter II. Suffice it to say here that the differentiation is useful largely for purposes of convenience in treatment. The fields of the engineering societies and of the experts in scientific management are gradually converging.

Scope of the Standardization Work of Engineering Societies

There are several engineering societies doing standardization work in the United States. The scope of this work varies from the presentation of technical papers at the annual meeting of the membership (as in the case of the Society of Naval Architects and Marine Engineers) to the highly elaborated scope and procedure of such an organization as the American Society for Testing Materials.

Taken as a whole the scope of the standardization work of the engineering societies is as broad and inclusive as the entire standardization movement itself. Several engineering societies concern themselves almost entirely with research work. For this reason, a great deal of the work conducted or coordinated by the National Research Council, the Engineering Foundation, the Horological Institute, the American Society of Mechanical Engineers, and the American Institute of Electrical Engineers, is of a scientific rather than an engineering character. In some cases the societies maintain research workers at the Bureau of Standards.[1] The same situation is true of a large part of the work of foreign engineering societies.

Besides carrying on research work, the engineering societies draw up specifications for materials, standardize nomenclature, signs and symbols, and suggest simplification of products; their staffs serve as a central bureau for the collection, interchange and general dissemination of information relating to the work of the society. A better understanding of the real meaning of the standardization work accomplished by the engineering societies can be obtained by examining

[1] For examples, American Society of Mechanical Engineers and the Society of Automotive Engineers.

the activities of three or four of the larger and better known societies.

Society of Automotive Engineers

The present Society of Automotive Engineers was organized in 1917, representing a fusion of the Society of Automobile Engineers and other proponents of the internal combustion engine.[1] It represented a continuation of the work of the Society of Automobile Engineers, which had been formed in 1910 following the demise of the Mechanical Branch of the Association of Licensed Automobile Manufacturers. Its membership, which is on a personal and largely on a professional basis, now includes 3,000 persons.

The Standards Committee, "which was organized in 1910 with 96 members comprised in 16 divisions . . . has grown until it now has 300 members organized into 29 divisions."[2] The society maintains two research associates at the Bureau of Standards, and is responsible for the administrative supervision of four research associates doing research in oils, maintained at the Bureau by the American Petroleum Institute and the National Automobile Chamber of Commerce.[3]

The Society publishes a handbook, biennially revised, which contains a complete set of its standard specifications. The last edition of the handbook includes more than 600 specifications. All standards proposals go to the standards committee, and from the committee are referred to the membership by letter ballot. Approval establishes the project as a society standard. "Advertising in the handbook is limited to automobile parts or materials made in accordance with the society's specifications, certificates being signed by proper officials of the manufacturing firms to the effect that the products advertised comply with the designated specifications."[4]

The range of activities covers practically every part of the automobile structure. "Of more than 100 current stan-

[1] George W. Dunham, "S. A. E. Standardization," *Journal of the S. A. E.*, December, 1921, pp. 371–374.

[2] S. J. Koshkin, "Engineering and Industrial Standardization," *Mechanical Engineering*, February, 1921, pp. 153–156.

[3] "Standards Yearbook, 1928," *op. cit.*, pp. 343–344.

[4] *Idem.*

dardization subjects, many include various parts and materials for airplanes; thrust ball bearings; automotive power plants and mountings; material specifications and tests; automobile headlighting specifications; tires and wheel equipment; screws, drills, and taps; a variety of mechanical parts and fittings; paints, varnishes, and enamels; and materials, such as substitutes for upholstery leather."[1]

The Society maintains very active relationships with other standardizing bodies. It is at present acting as joint sponsor for ten sectional committees functioning under the rules of procedure of the American Standards Association, is represented on thirteen other A. S. A. sectional committees, and is carrying on important cooperative work with "about thirty other committees or boards of other national organizations or governmental bureaus and departments."[2] Its most important liaison work in the technical field is done with the American Society of Mechanical Engineers and the Bureau of Standards. It maintains contacts in the automotive field with such organizations as "the National Automobile Chamber of Commerce, the Motor and Accessory Manufacturer's Association, the National Association of Farm Equipment Manufacturers, the National Association of Engine and Boat Manufacturers, the Rubber Association of America,[3] etc."

It is impossible to estimate, with any close degree of accuracy, the extent to which the recommendations and the standards of the Society of Automotive Engineers are used in the actual process of automobile manufacture, maintenance and repair. One article suggests that the standardization data contained in the S. A. E. Handbook are "universally used by the automotive engineer."[4] The close contacts of the membership of the Society with industry and the scope of the work done cooperatively with associations of manufacturers suggest the probability of wide use of the Society's standards. The organization is officially recognized by the National Automobile Chamber of Commerce, and receives from them an annual sum of $5,000 for standardi-

[1] *Idem.*

[2] *Idem.*

[3] Society of Automotive Engineers, "Our Society Why Not Yours?", pamphlet, 1928.

[4] S. J. Koshkin, *op. cit.*

zation, and other grants for research. A recent article in the *S. A. E. Journal*,[1] however, complains that the use of brand names and labels by manufacturers of motor oils has led many of them to oppose the printing or stenciling of S. A. E. viscosity numbers on the can-labels and barrel-heads. But even here the Society seems to be making definite headway. The history of its past activities seems to warrant the conclusion that the future will see a steady and significant widening of its influence in the industrial field.

American Society of Mechanical Engineers

A second engineering society active in standardization work is the American Society of Mechanical Engineers.

> "The early records of the society show that five years after it was founded (1885) a Standardization Committee on Pipe and Pipe Threads was appointed. This committee made its report the following year and from that time standards committees have been almost continuously at work. In 1892 the first report on the standardization of pipe flanges was published. It was revised and republished in 1900 and was again revised and extended during the years 1912–1914 and 1916–1918. As far back as 1901 another committee of the Society developed and printed a complete standard for pipe unions."[2]

Before the organization of the American Society for Testing Materials the Society "had committees at work developing standard tests and methods of testing materials. The first report of this kind was published in 1890."[3] In 1907 it made its first report on the standardization of screw threads. A standing committee on standardization was established in 1911 for the purpose of correlating this work. As one of the founder societies of the American Engineering Standards Committee in 1918, it has, since that date, carried on its standardization work under the "latter's procedure, with two notable exceptions, these being the A. S. M. E. Power Test Codes and the A. S. M. E. Boiler Code."[4] . . . These standards, very important from the point of view of power-plant efficiency and safety, have received wide ac-

[1] *Journal of the S. A. E.*, "Refiners Should Play Ball with S. A. E.," June, 1928, p. 673.

[2] American Society of Mechanical Engineers, "A. S. M. E. Technical Committees, 1927," p. 10.

[3] *Idem.*

[4] S. J. Koshkin, *op. cit.*, p. 158.

ceptance in industry. The Boiler Code has been adopted in nineteen states and fifteen cities.

The Society's work ranges from research to the publication of an influential journal and the formulation and publication of standards in every important field of mechanical engineering. At the present time it employs, at full or part-time work, sixty-nine research workers, eleven of whom are stationed at the Bureau of Standards. It is now sponsor or joint sponsor for twenty-two sectional committees on standards and five sectional committees preparing codes[1] under the procedure of the American Standards Association. It is also represented on sixty-nine additional A. S. A. standards committees.

All standards proposals go first to the standing committee on standardization. It organizes and passes upon the work of the Sectional Committee whether this committee is working under A. S. A. procedure or not. All projects receive full publicity in the Society's publication, *Mechanical Engineering*. Beginning January, 1928, each professional division, of which there are sixteen, will have its own quarterly publication.[2]

As joint sponsor for different projects under American Standards Association procedure, it does liaison work with such bodies as the Society of Automotive Engineers, Society for the Promotion of Engineering Education, the American Gas Association, American Society of Safety Engineers, National Board of Fire Underwriters, National Tool Builders Association, Manufacturers' Standardization Society of the Valve and Fittings Industry, etc.[3]

As with the Society of Automotive Engineers, there is no way of discovering the extent to which the standards and recommendations of the American Society of Mechanical Engineers are actually used in the mechanical industries. The membership, however, though on a purely professional basis, is made up of men who, for the most part, are on the engineering staffs of private corporations and are consequently engaged constantly in the task of drafting specifications, of formulating codes of good practice, etc. No doubt,

[1] "Standards Yearbook, 1928," *op. cit.*, p. 281.

[2] *Idem.*

[3] "Standards Yearbook, 1927," *op. cit.*, p. 330.

A. S. M. E. specifications are the basis of a considerable proportion of that work. Several trade associations and many private corporations have officially accepted, in full or in part, A. S. M. E. standards as the basis of their standardization work.[1]

American Institute of Electrical Engineers

The American Institute of Electrical Engineers has long been active in standardization work.

> "The appointment of a committee of seven in 1898 to develop standards and specifications covering generators, motors, and transformers marked the beginning of standardization activities of the A. I. E. E. The results of this committee work, approved in 1899, became and have continued with subsequent revisions to be recognized throughout the United States as the authoritative source of information on the terms and conditions which characterize the rating and behavior of electrical apparatus, with special reference to the conditions of acceptance tests. Subsequent reports of the Standards Committee in the form of Standardization Rules were issued in 1902 and 1906. These Rules comprise the substance of forty different groups of standards."[2]

The revised sections of the Institute's standards, each separately published, are placed under the procedure of the American Standards Association, to be issued later as American Electrical Standards. The Institute is, further, sponsor for nineteen sectional committees of the A. S. A. and is represented on twenty-seven others.

The work of the American Institute of Electrical Engineers, a great deal of which is highly technical, involves considerable close cooperation both with engineering societies, such as the American Society of Mechanical Engineers and the Institute of Radio Engineers, and with trade associations, such as the American Electric Railway Association, the Electric Hoist Manufacturers' Association and the National Electric Manufacturers' Association.

"Committees of the institute are now at work on the following standardization topics: Rearrangement of rules; Spanish translation; electric arc welding apparatus; light-

[1] For example, American Boiler Manufacturers' Association, Machinery Builders' Society, National Machine Tool Builders' Association.

[2] S. J. Koshkin, *op. cit.*, pp. 156–157.

ning arresters; telegraphy and telephony definitions; definitions and symbols; graphical symbols; measurement of test voltages in dielectric tests; storage batteries; general principles upon which temperature limits are based in the rating of electrical machinery and apparatus; switchboards for power and light; definitions of substation and related matters; air circuit breakers; rule for altitude correction; nomenclature."[1] Preliminary and final drafts of standards are published in the Journal of the A. I. E. E. It is also one of the most important representatives in the United States of the International Electrotechnical Commission, and is, through its liaison activities with that organization, engaged in international standardization work.

American Society for Testing Materials

> "The American Society for Testing Materials had its beginning in 1898, when there was formed in Philadelphia, an American Section of the International Association for Testing Materials, which had been organized in 1895 as a result of informal meetings of various European workers in experimental engineering that had been going on for fifteen years. It was soon realized by the American members that an independent organization could best carry out the objects that were in view, and in 1902 the members of the American Section brought about the incorporation of the American Society for Testing Materials, declaring its objects to be: 'The Promotion of Knowledge of the Materials of Engineering and the Standardization of Specifications and Methods of Testing.'"[2]

The Society's membership, which now totals some 4,200 (persons) (about 400 of whom are foreign), is made up of "individuals, companies, firms, corporations, industrial associations, testing laboratories, federal, state and municipal departments, universities and technical schools, technical societies and libraries. There are about 1,150 company, firm, corporation and industrial association members, and 2,750 individual members, the majority of the latter having affiliations with the various groups that have been named."[3]

In the twenty-four years devoted to the work the American Society for Testing Materials has developed "515 standard

[1] "Standards Yearbook, 1928," *op. cit.*, pp. 269–270.

[2] C. L. Warwick, "The Work in the Field of Standardization of the American Society for Testing Materials," *Annals*, *op. cit.*, May, 1928, p. 49.

[3] *Idem.*

and tentative specifications, methods of test and groups of definitions relating to materials. . . . These are published in two volumes: 'Book of A. S. T. M. Standards,' (1,850 pages) and 'Book of A. S. T. M. Tentative Standards' (900 pages), a total of 2,750 pages of Technical Standards."[1]

As indicated above this standardization work covers the following broad fields: "(1) the development of methods of testing materials, (2) the setting up of standard definitions and systems of nomenclature, (3) the formulation of specifications defining the quality and tests of materials and products, and (4) the preparation of recommended practices governing certain processes in the utilization of materials."[2]

The procedure by which projects are selected for consideration and adopted involves the application of three "basic principles": (1) producer and consumer should be brought together on an equal footing; (2) standards should be founded on accurate knowledge of materials and on suitable tests for determining such properties; and (3) all interested parties should be given every opportunity to express their views at each stage of development of the standards.

The scope of the work of the Society is very great. In the development of the standards, it cooperates very closely with other engineering societies, including the American Standards Association,[3] with the Bureau of Standards and other governmental and private laboratories in their research work, and with trade associations and private corporations.

Like the standardization work of the other engineering societies, the use of A. S. T. M. standards in industrial processes must rest on the merits of the particular standards. That they have been widely used is beyond doubt. "The society's cement specifications are the standard for that

[1] *Ibid.*, p. 52.

[2] *Ibid.*, p. 50.

[3] In a sense, neither the American Society for Testing Materials nor the American Standards Association is an "engineering" society. The recent reorganization of the American Engineering Standards Committee, which involved changing the name of the organization to American Standards Association, is a result of the recognition of this fact. Both the American Society for Testing Materials and the American Standards Association serve as clearing houses for placing standardization projects on a national basis. This is even more true of the American Standards Association than of the American Society for Testing Materials. For that reason, and on account of its unique position in the standardization movement in this country, the American Standards Association will be separately treated in Chapter VI of this volume.

material throughout the country. Its drain-tile and sewer-pipe specifications are accepted as standards by the manufacturers, and their use is urged by those concerned in the interest of high quality and standardization of product. Its metal specifications appear in the legal requirements, specifications, and codes of many states, municipalities and federal departments."[1]

The A. S. T. M. standards may be used by private firms without modification as reference and as the basis for company standards. They are also used widely in foreign trade.

> "Since 1916 the Department of Commerce has translated into French and Spanish over sixty specifications for materials active in foreign trade. Revised Spanish editions of some thirty-five of these being in greater demand commercially, have been issued; and fifteen specifications for materials entering into trade with Brazil and Portugal have this year (1928) been published in Portuguese. These foreign language editions of the A. S. T. M. specifications have been distributed by the Department of Commerce among the American Consuls and Commercial Attaches in various countries throughout the world and have been very largely used by American industries engaged in export business."[2]

Status of the Standardization Work of American Engineering Societies

A résumé of the work of the standardization activities of several other important engineering societies would serve only to emphasize facts brought out in the above survey. These significant facts may be briefly indicated:

(1) The membership, whether it be entirely on a professional basis as in the American Society of Mechanical Engineers and the American Institute of Electrical Engineers, or on a more general basis, as in the American Society for

[1] S. J. Koshkin, *op. cit.*, p. 158.

[2] C. L. Warwick, *op. cit.*, p. 57. See also, "Standards Yearbook, 1928," *op. cit.*, p. 72. Along this line appears an interesting comment from the *Iron and Coal Trades Review* (London): "Following upon the very large contracts placed latterly on the Continent of Europe for locomotives, rolling stock and steel rails, the High Commissioner for the Union of South Africa has issued invitations to various firms to tender for a quantity of locomotive boiler fire-box and miscellaneous plates specified to be in accordance with the requirements of the American Standard (A.S.T.M.) Specifications for material of this nature . . ." The approved makers were all American firms." Quoted in *Sustaining Members Bulletin*, *op. cit.*, July 12, 1928.

Testing Materials, is made up largely of men closely associated with industry and industrial processes in their professional capacities as technicians and consulting engineers.

(2) The standardization work of these societies is closely linked, for the most part, with the scientific fundamentals, through constant reference to research carried on under auspices of the societies, or by governmental and other research organizations with which the societies are in constant touch.

(3) Much valuable pioneering work has been done by these societies, and the intimate relationship existing between them and the trade associations and private companies, especially in recent years, is providing them with funds and furnishing them with an unparalleled opportunity to test the results of their projects by actual application to industrial processes.

(4) Between the more strictly "engineering" societies and the trade associations proper have grown up a good many societies, many of them entirely subsidized by a single trade, which form what might be called "transition links" between the engineering societies and the trade associations. Examples of these are the Manufacturers' Standardization Society of the Valve and Fittings Industry, the Institute of Radio Engineers, the American Institute of Baking, the American Bureau of Welding, the Cotton Textile Institute, the Underwriters Laboratories of the National Fire Protection Association, the American Railway Engineering Association, etc.

(5) The sphere of usefulness of engineering society standards is very wide. They are now being used as a basis for purchases in foreign trade on a rather significant scale.

(6) The overlapping of the activities of the different engineering societies, and of those of trade associations and private companies, has called for centralization, coordination and systematization of national standards to prevent duplication, overlapping and confusion. This has resulted in the setting up of the American Society for Testing Materials, the American Standards Association and the Division of Simplified Practice of the Federal Government as central clearing agencies.

Standardization Work of Foreign Engineering Societies

In Great Britain the engineering societies have taken a prominent part in the national standardization movement. The British Institution of Gas Engineers, the Institute of Petroleum Technologists, the British Chemical Standards Movement and the Radio Society of Great Britain are organizations of technicians interested in standardization work. Liaison work with trade associations[1] similar to that in operation in the United States has been set up. The following organizations were represented at a wireless apparatus standardization conference: "Radio Society of Great Britain, National Association of Radio Manufacturers and Traders, other manufacturers, the Valve Manufacturers Association, the institution of Electrical Engineers (Wireless Section), the British Broadcasting Co., the Wireless Retailers' Association, the Wireless Board, the General Post Office, and the technical press."[2]

The Institute of Petroleum Technologists includes in its work the standardization of nomenclature, the standardization of apparatus and the standardization of methods of test.[3]

As in the case of the engineering societies in the United States, close contact is maintained with the technical and highly-specialized scientific work of the national laboratories. The National Physical Laboratory occupies a position in England roughly analogous to that of the Bureau of Standards in the United States.

In Germany the engineering societies have carried their standardization work forward in close contact with the Deutscher Normenausschuss (German Standards Committee), since its foundation in 1917 by the Verein Deutscher Ingenieure (Union of German Engineers). Since the standardization work in Germany is largely dimensional[4] and

[1] Trade associations, as will appear later, are not nearly such important institutions in England or on the Continent as they are in the United States.

[2] *Sustaining Members Bulletin*, *op. cit.*, Aug. 22, 1925.

[3] *Ibid.*, July 30, 1925.

[4] The nature of this work and of the activities of the Deutscher Normenausschuss will be taken up in Chapter VI.

thus requires a sound scientific foundation and continuous reference to theory, standardization has been more of an engineering and scientific proposition in that country than elsewhere. Close contacts, consequently, are maintained with the Physikalisch-Technische Reichsanstalt (National Physico-technical Institute).

Work done separately, however, is much similar to the work of American engineering societies. The twelfth edition of the Standards Book (650 pages) of the Verband Deutscher Electrotechnicker (Association of German Electrical Engineers) lists its materials under four heads:

> "*Requirements*, (life and fire hazard questions—mandatory)
>
> "*Rules*, (stipulating how the requirements are to be carried out with the usual instrumentalities, when deviations are not justified by particular circumstances)
>
> "*Standards*, (providing exact indications in reference to construction, form, dimensions, material, weight, mechanical, electrical, or magnetic properties, etc., which are intended to be adhered to)
>
> "*Recommendations*, (recommendations which, after being tried out, will be promulgated in the form of Standards, Rules or Requirements."[1]

Of interest in the field of engineering standardization in Germany is the development of "standardization engineering" as a profession. Advertisements for standardization engineers and for such positions regularly appear in the engineering press.[2] This work seems to be closely associated with what is known in the United States as "scientific management." Five consulting engineering firms, having as their clients individual firms, both large and small, and trade associations, had been organized by 1923 to do standardization work.[3]

The standardization activities of engineering societies in

[1] *Sustaining Members Bulletin*, *op. cit.*, July 30, 1925. The Bulletin continues: "Some of the more important titles in the table of contents are as follows: agricultural installations; lightning protection; protective grounding in high tension installations; voltages below and above 100 volts; standard current strengths for apparatus; standards for copper; testing of electrical insulating materials; transformer and switch oils; rules for the rating and test of transformers, control apparatus, etc.; measuring instruments and meters; insulated and armored conductors; rotary switches; receptacles and plugs; warning placards; resuscitation measures; flash light batteries; telephone installations; radio broadcast receiving antennas; electricity on shipboard; railroad crossing requirements."

[2] *Sustaining Members Bulletin*, *op. cit.*, Dec. 6, 1923.

[3] *Ibid.*

other European countries seem to be modeled after those of either the German or the English Societies. One rather interesting development is found in a society of Russian engineers located in Berlin, which is engaged in the task of translating technical articles, abstracts and standards into Russian. These translations are sent to Russia and distributed by the government to technicians in that country.[1]

[1] American Engineering Standards Committee, *Main Committee Bulletin*, Number 60.

CHAPTER V

TRADE ASSOCIATION STANDARDIZATION

A SURVEY made by the Department of Commerce in 1926[1] showed sixty-nine trade associations reporting expenditures for standardization in that year; seventeen associations and societies reporting participation in standardization, the expenses of which are borne by the members; and eighty-seven associations and societies reporting no expenditure for standardization in 1926. The 1928 Bureau of Standards Yearbook[2] lists more than 240 trade associations working on their own standards, or cooperating with other bodies in the establishment of trade association standards.[3] The Proceedings of the American Trade Association Executives, for 1927,[4] lists among "Activities of Member Associations"[5] the member numbers of ninety-two trade associations reporting activity in the field of "Standardization and Simplification." The last Yearbook[6] of the American Standards Association lists among its cooperating bodies about 200 organizations that might be classified as trade associations.

This confusion may be more apparent than real, however. It may arise as the result of an incomplete check in some cases, lack of complete understanding of the meaning of the term "standardization," the difficulty of classifying an organization as a trade association, duplications, etc. The Eighth Annual Report of the American Trade Association

[1] A survey that attempted to discover the amount of money spent by trade associations on standardization. The report never reached the stage of publication.

[2] "Standards Yearbook, 1928," *op. cit.*, pp. 258–352.

[3] This number was picked out of the entire list on the basis of the rather loose definition of trade association given on page 78.

[4] American Trade Association Executives, "Proceedings and Addresses, Eighth Annual Convention," October, 1927, p. 224.

[5] This list includes several organizations that obviously should not be included under the name trade associations.

[6] "Yearbook, 1928," *op. cit.*, pp. 56–65.

Executives, for example, fails to list among its member bodies working on standardization, the National Electric Light Association, the National Electrical Manufacturers' Association, the American Petroleum Institute, the Portland Cement Association, and several others. Some of these omitted associations, especially the ones listed above, are outstanding leaders in the standardization movement among the trade associations. The Bureau of Standards Yearbook, on the other hand, lumps together "Technical Societies and Trade Associations," so one is unable to determine just how many of the organizations listed there should be included under the head of trade associations.

There is no need here of going into a discussion of just what constitutes a trade association.[1] It will suffice if a trade association is thought of as an organization of independent producers, distributors or consumers (or both) of goods or services, with the object in mind of forwarding the business interests of the trade or industry concerned. Technical societies separately organized by a trade association for the use of its membership would be included in this definition.

The Range of Trade Association Standardization Work

The list of subjects covered by trade association standardization activity would be in some fields almost as varied as the list of commodities manufactured by the members of the associations. Such a list, compiled by the Bureau of Standards in 1923,[2] includes all kinds of electrical, gas, and machine equipment, structural steel, paints and varnishes, gages, scientific instruments, safety codes, business forms, etc.

[1] "Proceedings and Addresses," *op. cit.*, answers the question "What is a Trade Association?" as follows: "A trade association is an organization of producers or distributors of a commodity or service upon a mutual basis for the purpose of promoting the business of their branch industry and improving their service to the public through the compilation and distribution of information, the establishment of trade standards and the cooperative handling of problems common to the production or distribution of the commodity or service with which they are concerned." This definition has been accepted as authoritative by the National Industrial Conference Board. See, "Trade Associations: Their Economic Significance and Legal Status," New York, 1925, p. 7.

[2] "Alphabetical List of Subjects Covered by Standards Published by National Organizations in America," May 29, 1923, enclosure accompanying letter from Bureau of Standards.

The types of standardization involved in the work of the trade associations are, taking them as a whole, quite broad. Simplification, standardization of terms, definitions and technical nomenclature, quality and dimensional standards, codes of good practice, etc., are worked out either within the separate associations themselves; cooperatively with other trade associations, the technical societies and the Federal Government; or through sponsorship for sectional committees working under the procedure of the American Society for Testing Materials and the American Standards Association.

There are many fields into which standardization, as a recognized procedure, has not penetrated. In many cases, trade associations seem to be unaware of the existence of the standardization technique, of the way to go about achieving it, the groups from which to obtain technical information, or the uses and advantages to be derived from the application of standards to their own industry. In many cases, such as, for example, the drug and cosmetic industry, current practice and vested interest resist the introduction of standards in the trade. Opposition to standardization is frequently based upon more or less complete misunderstanding of its meaning and effects. In some cases, rather elaborate standards have been worked out but have never been used by the membership; and in still other cases, it is felt that standardization is inherently not applicable to the industry.

In most cases where standards are being used, and where standardization is a definitely accepted program, the organization of the work is rather loose and poorly articulated. This situation is probably largely due to the very newness of the movement, since with most of the trade associations, standardization work has a history of less than a decade.

A further reason for lack of vigor in this direction may be the peculiar position occupied by the trade association with respect to its membership. While it is a central body, it does not possess law-enforcing powers. Consequently, while it can standardize, its standardization work remains a paper achievement until the membership voluntarily incorporates the association standards into industrial usage. It is there-

fore very difficult to gage the extent to which trade association standards, even where they exist, are adhered to in actual practice.

However, in cases where the maintenance of minimum quality standards is a central issue with the association, pressure may be brought to bear upon recalcitrant members by the issuance of trade association stamps or labels as a guarantee of quality to users. The Standards Yearbook lists[1] twenty national trade associations issuing such symbols, labels, or certificates of approval.[2] At least seven[3] of these associations enforce compliance with the standards after the issuance of the label, by withdrawal of the right to use it or by periodic inspection.[4] These association certificates are sometimes used as the basis of advertising by the association membership.[5]

Several trade associations have linked their standardization work to fundamental technical research. The 1928 Standards Yearbook lists eleven associations that maintain their own laboratories, and fifteen that maintain research associates at the Bureau of Standards in Washington. Some maintain associates working in college and university laboratories. Often, associations whose membership is made up of small or medium-sized firms, which can not practicably operate their own laboratories, set up cooperative research activities through research associateships at the Bureau of Standards or in other ways. Where competition pits industry against industry, as is rapidly becoming the case with the silk, cotton, rayon and woolen industries, and with the gas and electric refrigerator industries, research work, closely connected with standardization, may mean the success or failure of an entire industry.

[1] "Standards Yearbook, 1928," *op. cit.*, pp. 258–352.

[2] See Appendix I of this volume.

[3] Namely: American Gas Association, American Petroleum Institute, Associated General Contractors of America, Associated Knit Underwear Manufacturers of America, Concrete Products Association, Malleable Iron Research Institute, and Southern Pine Association.

[4] Examples of enforcement of trade association standards by periodic inspection are the American Gas Association, the Concrete Products Association and the Southern Pine Association.

[5] Examples are the American Gas Association, the Malleable Iron Research Institute and the Southern Pine Association.

It should be noted, in passing, that the decade of greatest trade association activity in the field of standardization is also the first decade of activity of the American Standards Association. As will be shown later in dealing with that organization, the American Standards Association is a "single-purpose" body, whose function is to serve as a clearing house for the establishment of national standards. It provides the forum, and its mechanism provides the co-operative technique for bringing independent bodies together in their standardization work.

A similiar function in a different field is performed by the Division of Simplified Practice of the Department of Commerce. The number of trade associations that actively co-operate with this body and the American Engineering Standards Committee has steadily increased, suggesting the serious attention which the associations are giving to standardization.

Some conception of the problems, the scope and the significance of trade association standardization work can be gained by a brief examination of the work of some of the better-known associations.

American Gas Association

The American Gas Association centralizes its standardization work in its Cleveland Testing Laboratory, organized in 1925 for the object of setting up "basic requirements for safe operation, economical performance and reasonably durable construction"[1] of the appliances manufactured by its membership.

The significance of this step for the gas industry is very great. It has been estimated[2] that there are 52,000,000 actual consumers using gas in "about 9,800,000 ranges, 3,400,000 water heaters, 4,400,000 space heaters and hundreds of thousands of central house heating installations, not to mention other appliances." The gas industry is meeting strenuous competition from the oil, wood, coal and elec-

[1] American Gas Association, "Laboratory Testing Policies," 1928, p. 2.

[2] Charles W. Person, "What is the Big Idea Behind the American Gas Association Testing Laboratory?" *Public Service Magazine*, August, 1927.

tric heating units and appliances, and from oil and electric cooking and lighting appliances.

The difficulties to be overcome in this industry are about as great as might be imagined in any field. ". . . there are no less than 244 manufacturers of gas ranges in the United States and 141 manufacturers of space heaters. There are, furthermore, thirty-six plants turning out central house heating units, and about fifty manufacturers of miscellaneous appliances. Altogether, the number of manufacturers reaches 570, and the total number of different models or types of appliances is 10,000 and more."[1] Added to these are the occasional "flyers," those who come into the business to make money out of a particular appliance, and then leave.

There is much confusion, also, with respect to the types of gas delivered to the consumer in different parts of the country. "There are about two thousand gas companies in the United States serving a large number of different qualities of gases at various pressures. The terms Natural, Mixed, Oil, Coke, Coke Oven, and Carbureted Water Gas are only general and do not indicate the number of different qualities of gases supplied in each group. In fact it is rather difficult to find two gases which possess exactly the same constituents. Changes in pressure, specific gravity and heat content all have a decided influence on the operation of appliances."[2]

In face of these difficulties and the fact that "Gas ranges, for example, must successfully pass more than 160 tests, 90 per cent of which are to insure appliance safety,"[3] the association reported "more than 5,000 models of gas ranges approved as of August 1, 1927."[4]

Appliance specifications are under the charge of the General Specifications Committee, representing "the manufactured and natural gas industries, the Bureau of Standards, Bureau of Mines, U. S. Public Health Service and the Master Plumbers' Association."[5] In the research work un-

[1] *Idem.*

[2] American Gas Association, "The A. G. A. Appliance Testing Laboratory," p. 7.

[3] R. M. Conner, "The Development of Safety Standards for Domestic Gas Appliances, by the A. G. A.," *Annals*, *op. cit.*, p. 148.

[4] American Gas Association, "The A. G. A. Laboratory as Others See It," p. 3.

[5] *Idem.*

derlying the forming of these specifications, the committee collaborates very closely with the Bureau of Standards. In the formulation of standards affecting other industries, and in the development of gas safety codes, it works in a sponsor capacity under the American Standard Association procedure.[1]

When the specifications have been worked out, they are printed and sent to all gas companies and manufacturers who are members of the American Gas Association[2] for criticism and approval. Following approval, the specifications are binding upon the membership within a year after acceptance. Upon acceptance of the specifications, appliances are submitted to the laboratory for tests.[3] The successful issue of the test entitles the manufacturer to use the blue star Laboratory Approval Seal and to advertise his product as an Approved Appliance.

The Certificate of Approval held by the manufacturer from the Testing Laboratory is good for one year only. The following year all appliances must be again submitted to the laboratory for test of deviation from the standard. The laboratory does not issue disapproval lists but confines its activities to approval.

No completely accurate data are to be had upon the degree of adherence to the Association standards. Once the label is given, it stands for the succeeding year as an association guarantee, and it is taken for granted that its specifications are followed. Nor is there any accurate gage of the percentage of the total industry included in the work of the association. Certainly it is increasing steadily.

The Electric Industry

The leaders in the standardization work of the electric industry are the American Institute of Electrical Engineers,[4] the National Electric Light Association, the National Electric Manufacturers' Association, the American Electric Railway Association and the Association of Electragists.

[1] "Standards Yearbook, 1928," *op. cit.*, p. 266; "Yearbook, 1928," *op. cit.*, p. 55.

[2] "The A. G. A. Appliance Testing Laboratory," *op. cit.*, p. 7.

[3] Tests are made for both members and non-members. Test fees for non-members are about one-third higher than those for members.

[4] Work of this engineering society has been outlined on pp. 69–70.

National Electric Light Association

The National Electric Light Association does practically no standardization work as an association. All cooperative work of this kind with other organizations is centralized in the Codes and Standards Committee, organized in 1926.[1] Although the committee may, from time to time, "formulate drafts of specifications which are offered to the membership as recommended practices,"[2] the body of its standardization work is accomplished as sponsor, or joint sponsor representing the light and power group, for standardization projects working under the procedure of the American Standards Association. This work has brought it into a close contact with the electrical standardization work of interest to the American Institute of Electrical Engineers, the National Electric Manufacturers' Association, the American Electric Railway Association, the Association of Edison Illuminating Companies, the American Society of Mechanical Engineers, and others.

National Electric Manufacturers' Association

The National Electric Manufacturers' Association "was organized for the standardization, improvement in production, and the increase in distribution of electric machinery, apparatus and supplies."[3] The formation of the association was brought about by the merging in 1926 of the Associated Manufacturers of Electrical Supplies, Electrical Manufacturers' Council and the Electric Power Club.

Since the establishment of the Association considerable progress has been made in the standardization of electrical nomenclature, the standardization of electrical equipment, and the publication of handbooks, sheets of instruction and specifications "covering standards for the manufacture, performance, and test of electrical apparatus and supplies," including "instructions for their proper installation, opera-

[1] National Electric Light Association, Serial Report of the Codes and Standards Committee, "Principles and Practices in Code and Standards Operations," 1926–1927.

[2] "Standards Yearbook, 1928," *op. cit.*, p. 324. An interesting example of this work is to be found in the "Overhead Systems' Reference Book," published by the N. E. L. A. See, *Sustaining Members Bulletin*, *op. cit.*, Jan. 23, 1928.

[3] S. J. Koshkin, *op. cit.*, p. 157.

tion, and care."[1] The Handbook of Radio Standards, published semi-annually, is a veritable lexicon of radio definitions, tests and equipment tolerances.

This standardization work involves cooperation with the professional engineering societies, American Standards Association, other trade associations interested in the electrical field, and the Federal Government. The Association is now sponsor or joint sponsor for seven sectional committees of the A. S. A. and is represented on forty additional committees.

As with the other societies, it is impossible to discover the extent to which the Association standards are used by the membership. Although these data would seem to be of considerable importance for many purposes, the association has never seen fit to gather them. The widening scope of its standardization work would seem, however, to justify the conclusion that its standards are finding their way into practice on an increasing scale.

Association of Electragists

"The Association of Electragists, consisting of contractors and contractor dealers, has developed standard forms and accounting methods and is interested in local electrical codes."[2] It is principally interested in minimum standards and in raising the quality and price of home wiring installation, which it is attempting to popularize by its "Red Seal" standards campaign.

American Electric Railway Association

The American Electric Railway Association committee rules provide for the preparation and adoption for the use of its membership of standard articles, designs, specifications, units, terminology, measurements and methods "as are applicable to general use and represent the best practice."[3] They provide, further, for the promulgation of Recommendations and Miscellaneous Methods and Practices.

[1] "Standards Yearbook, 1928," *op. cit.*, p. 325.

[2] U. S. Dept. of Commerce, "Trade Association Activities," Domestic Commerce Series No. 20, Washington, p. 174.

[3] American Electric Railway Engineering Association, "Committee Rules," 1928, p. 16.

The actual standards worked out are the product of the American Electric Railway Engineering Association, a subsidiary association. Completed standards are published in the association's Engineering Manual. The use of the standards by the association membership is in no way obligatory. Consequently, the association has compiled no data on the degree of use given its standards.

American Railway Association

The American Railway Association was one of the great pioneers in standardization work among the trade associations. Even its predecessor organizations, the American Railway Master Mechanics' Association, the Master Car Builders' Association, etc., had begun and carried through significant and far-reaching standardization of gages, couplers, signal lamp oils, time, etc.

Although four of the seven divisions of the American Railway Association are interested in standardization,[1] the bulk of the association standardization work is accomplished by the American Railway Engineering Association, a dependent organization, which is in turn divided into three sections—construction and maintenance, electrical, and signal.

The standardization work of these sections consists of the drafting of specifications for purchase, the codification of safety codes, the simplification of "general sizes, dimensions and styles,"[2] standardization of certain of the technical features of structural design, etc. Such standards are of the nature of "Recommended Practice" findings, and are in no sense imposed upon the membership. Adoption of the standards waits upon their own proved value to the user.

Besides the standardization work done within the association, the American Railway Association cooperates with the American Standards Association in the establishment of national standards. It is represented on several joint committees and sectional committees and is acting as joint sponsor for two projects functioning under the A. S. A. procedure.

[1] Namely: Operating Division, Engineering, Mechanical Division, and Purchase and Stores Division. See, "Standards Yearbook, 1928," *op. cit.*, pp. 275–278.

[2] American Railway Engineering Association, "Report of Special Committee on Standardization," Oct. 28, 1927, p. 4.

The survey of the Special Committee on Standardization of the American Railway Engineering Association[1] gives some rather detailed information on the degree of adherence to association standards on the part of the member companies. This report, which gives in summary fashion a résumé of the findings of twenty-four special committees, is quite unique and deserves the serious attention of any one interested in this field. The range of the committee survey is in itself very interesting. The committee headings are: Roadway; Ballast; Ties; Rail Track Buildings; Wooden Bridges and Trestles; Masonry; Grade Crossings; Design Protection and Elimination; Signals and Interlocking; Records and Accounts; Rules and Organization; Water Service; Yards and Terminals; Iron and Steel Structures; Economics of Railway Location; Wood Preservation; Electricity; Uniform General Contract Forms; Economics of Railway Operation; Economics of Railway Labor; Shops and Locomotive Terminals; Cooperative Relations with Universities.

In all of these divisions, specifications, sheets of instructions, codes of practice, formulæ for computation, systematic processes for conversion of theoretical material into actual practice, etc., are laid down. The extent to which these are used is indicated wherever it was possible to get data, and a brief statement summarizes the present status of the work in each field. Some of the railroads have adopted the recommended standards completely, while others have modified them in some particular or other to suit their own special needs.

American Petroleum Institute

The standardization work of the American Petroleum Institute has dated from its St. Louis meeting of 1923. The program of the Institute is one of the most complete and thorough to be found in any industrial field and is probably unique with respect to the speed and energy with which it was organized and set in productive operation.

The simplification, standardization and improvement of well oil-drilling equipment was felt to be a national problem.

[1] *Ibid.*, pp. 6–15.

The confusion in the drilling field existing at that time was accentuated, to a considerable degree, by the chaos of sizes, shapes and quality of drilling equipment and parts. "It was almost unbelievable . . . how little the ordinary operator knew about the material he was using. There were 20-odd different grades of steel used in pipe by various manufacturers. No two used the same tapered thread or the same character of connections. There were hundreds of different tool joints not interchangeable, millions of dollars worth of stock because of various notions about a particular joint for a desired purpose when half that material would ordinarily be required."[1]

Special standardization committees have been organized to work on the various types of equipment. Bulletin 101 of the American Petroleum Institute[2] lists committees working on standards for belting, oil field boilers, cable drilling tool joints, rotary drilling equipment, rigs and derricks, rig irons, wire rope and manila cordage, pumping equipment, steel tanks for oil storage, etc. The institute has done some liaison work with the American Standards Association and with professional societies, particularly the American Society for Testing Materials and the American Society of Mechanical Engineers, but for the most part its standardization work has been confined to its own organization. Some of its specifications have been accepted by other trade associations, as was the case in the adoption by the Rubber Association of America of A. P. I. rubber belting specifications.

A feature of the standardization program of the American Petroleum Institute has been its attempt to increase the use of the A. P. I. Monogram. Manufacturers of materials that meet the A. P. I. specifications are licensed by the Institute to use the monogram on their products. "Practically every manufacturer of tubular material in the United States and Europe has been licensed to use the A. P. I. monogram on pipe."[3] . . . "Licensed by the American Petroleum

[1] W. T. Anderson, "One Place Where Oil Industry Got Together," *Oil and Gas Journal*, Sept. 22, 1927, p. 106.

[2] "A. P. I. Standardization Bulletin No. 101," Dallas, 1928, p. 143.

[3] J. Edgar Pew, "Specifications Completed on All Pipe," *Oil and Gas Journal*, *op. cit.*, pp. 28–29.

Institute in accordance with standards adopted, nine domestic and two foreign manufacturers are authorized to make and distribute standardized rig irons[1]. . . ."

The Lumber Industry

Pioneering work in lumber standardization was done by the various hardwood lumber associations, which for many years have maintained an elaborate inspection service. At the present time, standardization work in the soft lumber industry is, for the most part, centralized in the National Lumber Manufacturers' Association, an organization comprising thirteen regional associations of lumber manufacturers and timber owners.[2]

Standardization in this field is unique in some respects. Standardization of nomenclature and the grade-marking of lumber are designed to secure certified quality to the purchaser, where quality is not so much a matter of manufacture as of selection of the particular quality desired for a particular use.

> "The appeal of the lumber industry for wider and improved use of its products must be founded upon lumber properly manufactured and prepared, reliably and uniformly graded, and sold under suitable guarantees, the necessity of which has been strongly emphasized by wholesale and retail dealers, architects, engineers, contractors, purchasing agents and industrial consumers in response to a thorough research made by Association officials and field engineers. . . ."[3]

Several of the member associations have set up lumber standards and inspection rules, and have promoted the use of stamps and monograms. The Southern Pine Association enforces compliance with the association standard by a system of inspection. These grade-marks, however, may certify certain qualities only. ". . . The Southern Pine Association grade-mark is, in practice, ordinarily used on dry lumber only. The Northern Hemlock grade-mark is ordinarily put on green (or partially seasoned) lumber, al-

[1] H. J. Lockhart, "Inception, Progress, and Consummation of Standardization of Rig Irons," *Oil and Gas Journal*, *op. cit.*, p. 147.

[2] "Standards Yearbook, 1928," *op. cit.*, p. 328.

[3] National Lumber Manufacturers' Association, "Questions and Answers on the Plan of Trade-Marking and Grade-Marking of Lumber," April 1, 1928, p. 3.

though the manufacturers do not ship green lumber by preference. Present grade-marking practice in the Douglas fir region follows its grading rules in making no differentiation between green and dry lumber, except of course in the select grades. Grade-making in hardwoods, to the limited extent to which it is practiced, is practically confined to seasoned lumber."[1]

The National Lumber Manufacturers' Association has recently taken up the project of establishing national lumber grades as American standards. It is proposed to back the brand on the market by an Association guaranty. Failure of compliance makes of the guaranty a binding financial obligation, to be borne by the National Lumber Manufacturers' Association, with reimbursement for its outlay to be met by the mill that branded and shipped the lumber.[2]

In some sections, lumber standardization has met with the enthusiastic support of the manufacturers; in other sections the reverse has been the case. A proposal of the National Lumber Manufacturers' Association to standardize the term California White Pine, so as to exclude the advertisement and sale of pondosa, a yellow pine, under that name, met with the strenuous opposition of the California White and Sugar Pine Manufacturers' Association.[3]

The association has been instrumental, further, "in formulating specifications for maximum spans for joists and rafters, building code limitations on floor areas in buildings, details of heavy timber mill construction, fire-safe industrial buildings, frame construction details, and recommended requirements for building codes."[4] This work has brought it into contact with the American Standards Association, the Bureau of Standards, the National Committee on Wood Utilization, the American Railway Engineering Association the American Society of Agricultural Engineers, and others. The Department of Commerce has very actively cooperated with the lumber interests in standards. The greater part of the technical work involved in this task has been done in the

[1] *Ibid.*, p. 7. [2] *Ibid.*, p. 8.

[3] "Minutes of the General Standardization Conference on Lumber," held under the auspices of the Department of Commerce, May 3, 1928. Files, American Standards Association.

[4] "Standards Yearbook, 1928," *op. cit.*, p. 329.

Forest Products Laboratory, of the United States Forest Service, located at Madison, Wis.

Standardization Work of Other Trade Associations

As was pointed out above, no one knows definitely just how many trade associations have definite standardization programs under way, nor quite how thorough the work of this phase of trade association work is. Noteworthy work has been done by several associations in certain more or less unique directions.

The American Bankers' Association has simplified and standardized bank checks. The American Institute of Baking has standardized baking machinery and equipment. Safety work has, in many respects, become an inter-association task. The National Fire Protection Association, the Underwriters' Laboratories, the American Mining Congress, the American Standards Association through its Safety Code Correlating Committee, and many others have carried this work to what might almost be called a finished state in several industries.

The Heating and Piping Contractors' National Association has carried its certification program to the stage that a guaranty of certified heating installation forces the Association to make "every single case good"[1] by financial reimbursement for failure of the equipment due to defects of design or installation. The Laundryowners' National Association has published a Manual of Standard Practice for the Power-Laundry Washroom. The Malleable Iron Research Institute, among others, has worked out a uniform, standard cost accounting system. The American Drug Manufacturers' Association and the American Pharmaceutical Manufacturers' Association recently submitted to the Food, Drug, and Insecticide Administration of the Department of Agriculture their fourth report "Containing recommendations for tolerances on certain medicinal tablets."[2]

The Portland Cement Association, in cooperation with the American Society for Testing Materials and the Bureau of

[1] Heating and Piping Contractors National Association, *Official Bulletin*, 1928, p. 73.

[2] Commercial Standards Group, *Monthly News Bulletin*, May 15, 1928.

Standards, has worked out specifications and tests for Portland cement which have been adopted on a nation-wide scale. Practically all manufacturers produce their cement in accordance with these specifications.[1] The National Association of Purchasing Agents has been active in the working out of standard invoices, letter-sizes and business documents. The Cotton Textile Institute has recently begun the standardization of textile nomenclature and certain quality features of textile materials.

Fields in Which Standardization by Trade Associations Has Not Been Set Up

It is difficult to say much with respect to industrial fields in which no standardization work has been done by trade associations that will not be subject to challenge. Some standardization work of an unconscious sort has been done in nearly every field. But the intention here is to indicate some of the fields in which no deliberate, organized standardization work has been undertaken by a recognized trade association. The fact that some persons may feel that certain fields definitely lie outside the realm of standardization technique, or that trade associations capable of handling the issue do not exist in certain industries does not invalidate the statement that in those fields consciously worked out standards do not exist.

In the first place, it might be pointed out that many trade associations, by reason of their constitution and by-laws, time of meeting, lack of a permanent office and trained secretariat, etc., are not equipped to handle standardization work. In the second place, there are many fields in which the concept of standardization has scarcely penetrated, even though the organization is there to handle it.

There is practically no standardization work being done in the hardware industry, even though qualities of tools, interchangeability of parts, certified tools and devices, etc., are engineering problems, and standardization would seem to be highly desirable from almost every point of view. There has been no attempt in the industry to standardize domestic

[1] "Standards Yearbook, 1928," *op. cit.*, p. 337.

or office furniture. Doors, windows, sashes and screens have not been standardized as to dimensions or quality on an industrial basis. Office appliances such as typewriters and adding machines have not been standardized with reference to interchangeability of such parts as ribbons, keys, springs, screws, ribbon spools, etc. Parts and appliances pertaining to plumbing equipment are just now being taken up for standardization.

Household equipment and equipment parts have been scarcely touched by industrial standardization. Textiles, aluminum ware, the elements of vacuum sweepers, etc., have to date not been considered as subject to the standardization technique, although considerable work along this line has been done in foreign countries.[1] There are thirteen different, and for the most part obviously irrational, methods of rating the heat capacity of household heating units such as boilers and radiators. Most of these methods are not comparable. Even an engineer can not compare different heating units without reference to some one of these methods to the exclusion of the others.

Where competition is between entire industries, standardization has proven to be an important factor in saving some industries from competitive ruin. The manufacturers of zinc, for example, hope by establishing standards in the galvanized iron industry to win back for manufacturers of sheet iron and steel an important field of consumption which they have lost, and which they at one time dominated. The brick manufacturers have recently taken up standardization on a larger scale than heretofore as a method of combatting the competition of the cement industry in building. The tile and marble industries and other makers of walk-way surfaces have recently taken up standardization as a partial solution to the difficulties of competition between their industries and those producing rubber, linoleum, abrasive compositions and other new types of floor surfacing materials. A fruit and preservers' association took up standards of quality and purity as a method of winning a market, since in no other way could this industry compete with the quality of the jellies, jams and preserves put up by the average housewife.

[1] See "DIN 1917–1927," *op. cit.*

Legal Status of Trade Association Standardization Activities

There are two important aspects to the question of the legality of trade association standardization activities. In the first place, there is the problem of government intervention in certain fields in order to establish and to maintain by inspection, minimum and absolutely essential standards in case of the default on the part of the responsible organizations in the particular industry. In the second place, there arises the question of the establishment of partial or complete monopoly and the introduction of practices leading to "unfair competition" and restraint of trade, as defined by the federal courts.

The federal Grain and Cotton Standards Acts, federal legislation relating to certain essential conditions in railway operations, federal legislation in the radio field[1] and the federal Pure Foods and Drugs Act, are instances where the Federal Government officially interfered with business processes in order to establish certain minimum standards as a basis for the conduct of those business processes. A recent American Standards Association project, a safety code for the construction industries, was practically forced upon the building industry by the threat of government action in the event that the industry itself failed to take action.[2]

The peculiar position of the trade associations in the United States, where there is the threat of legal action under the authority of the Sherman and Clayton Anti-Trust laws and the body of common law built upon interpretations of court decisions given under those statutes, has probably been an important factor in the apparent hesitancy with which trade associations have taken up standardization work. There is, however, but one case where the Supreme Court has touched directly upon this aspect of the activities of the trade associations. In the Maple Flooring Case,[3] the Court referred to standardization as one of the "many acti-

[1] See, J. W. Jamieson, "Tendencies of the Government to Absorb Association Activities," 1926.

[2] See, American Engineering Standards Committee, "Minutes of the Conference on Proposed Rules for Construction Industries," June 29, 1928.

[3] *Maple Flooring Manufacturers' Association et al. v. U. S., 268 U. S. 563.*

vities to which no exception is taken by the Government and which are admittedly beneficial to the industry and to consumers, such as cooperative advertising and the standardization and improvement of its product."

In the Gypsum and Tile Manufacturers' cases,[1] indirect reference was made to standardization in the statement that it was permissible for trade associations "to deal with engineering and trade problems pertinent to the industry for the purpose of advancing the use of Gypsum products," and "to deal with engineering and trade problems for the purpose of advancing the manufacture and use of tiles. . . ."

These references, combined with the fact that the trade associations most active in the standardization field have not been legally restrained in their activities in that direction, make reasonably certain the legality of such trade association activity. Should abuse of the technique develop so that the effect of standardization is the complete elimination of price competition, or so that certain competitors engaged in the legitimate manufacture of a good quality product suffer a curtailment of their business, it is probable that the face of the situation will be changed.[2]

Standardization Activities of Trade Associations in Foreign Countries

Trade associations in foreign countries have carried on extensive standardization work in some fields. In France, L'Union des Syndicats de l'Electricite, a federation of thirteen trade associations in the electric industry, has carried on very extensive standardization work. Centralization of the work in this organization has made possible a wider representation of the different interested groups in the industry and a better unified and more general acceptance of

[1] *U. S. v. Gypsum Industries Association*, U. S. District Court, S. D. New York, In Equity, No. E. 25–215, Jan. 4, 1923, par. (2) (b), p. 4; *U. S. v. Tile Manufacturers' Credit Association*, U. S. District Court, S. D. Ohio, In Equity, No. 201, Nov. 26, 1923, par. (4) (b), p. 5. Cited in "Trade Associations: Their Economic Significance and Legal Status," *op. cit.*, p. 186.

[2] For an excellent summary of the legal status of the standardization work of trade associations, see, "Trade Associations: Their Economic Significance and Legal Status," *op. cit.*, 179–190; also, Benjamin Kirsh, "Trade Associations, the Legal Aspects," New York, 1928, pp. 208–227.

its recommendations than is possible in the United States. The standards of l'Union des Syndicats de l'Electricite cover all the stages of manufacture of the raw materials used in the making of electrical apparatus, the delivery of the electricity and the operation of the finished electric appliances, whether for domestic or commercial uses. Its 1924 yearbook, of some 1,500 pages, contains among other things an elaborate set of specifications, safety codes, rules for installation and maintenance of equipment, etc.[1]

The German Federation of Bill-posting Agencies has worked out a German national standard system of paper sizes as the basis for posters. This work involved cooperation with the Associations of Book Printers, Lithographers and Rotogravure Printers, the Federation of German Commercial Printers, and others.[2] The German State Railway Association has recently adopted "a series of standard forms and dimensions for oil grooves in bearings of different materials including cast iron and cast steel; wrought steel; brass, bronze and red brass; and Babbitt metal."[3] The Association of German Bicycle Manufacturers has set up standards for the bicycle industry.[4] The Association of German Steel Manufacturers and the Association of German Iron Foundries have adopted a basis for the comparison of analysis of pig iron and steel.

In England considerable standardization work has been done by the trade associations, but it seems to have consisted, for the most part, of the question of ways and means and the degree to which standards worked out by the various engineering societies, private companies and the British Engineering Standards Association should be adopted into industrial usage.

Other European countries have trade associations interested in standardization. In general it would appear that foreign trade associations are in somewhat closer connection with the central standardizing body than is the case in the United States. The general range of foreign trade associa-

[1] L'Union des Syndicats de l'Electricite, "Rapport sur la Normalization du Material Electrique en France," Paris, 1924.

[2] *Sustaining Members Bulletin*, *op. cit.*, Mar. 10, 1927.

[3] *Ibid.*, May 10, 1927.

[4] *Idem.*

tion standardizing activities is essentially similar to that carried on in the United States. Research work, the drafting of specifications, the codification of safety codes, rules for operation and maintenance, etc., as recommendations to the industries concerned are conducted in a manner similar to that in practice in this country.

Summary of the Status of Trade Association Standardization

(1) Activity in this field on the part of trade associations is, with a few notable exceptions, a matter of the last decade, is spreading rapidly into a large number of industries and is gradually being put on a systematic basis.

(2) Since industrial standardization is largely an engineering matter, and since trade associations are, for the most part, organized on a national basis, this work has emphasized cooperation with the various engineering societies and with the departments of the Federal Government interested in standardization, has brought about the centralization of the work under the American Standards Association and has revived interest in systematic scientific research.

(3) Trade associations of manufacturers or producers of raw, semi-finished or finished producers goods have made the greatest progress in standardization. Manufacturers of finished goods for consumer use, with some notable exceptions, have been less aware of the standardization technique, processes and possibilities, and less concerned in having their associations take up this work.

(4) The most thorough work seems to have been done in the drawing of specifications for purchase of material and the working out of standard safety codes.

(5) Certification of quality, by the issuance of trade association monograms, labels or symbols indicating the fulfillment of certain minimum requirements for materials, methods of manufacture and performance capacity, is becoming an important feature of trade association standardization. Rarely are such guarantees backed by the promise of financial reimbursement for failure of the goods to meet specifications.

(6) Industrial competition seems to be, at the present time, one of the most important incentives leading to trade association standardization.

(7) The legality of technological standardization seems assured. Its use for the purpose of restraining trade, under the courts' interpretation of the anti-trust acts, is not a matter of standardization but of the misuse of a tool.

(8) Foreign trade associations have done considerable standardization work similar to that accomplished by associations in the United States. Trade associations abroad occupy a somewhat more favorable legal status in this respect, particularly in Germany, than in the United States.

(9) Comparatively few data exist in any industry, relating to the degree of adherence to trade association standards on the part of the member companies. Collection of these data is often difficult and the results unsatisfactory. From the point of view of a knowledge of the advantages and disadvantages of standards in particular fields, the collection of this material would seem to be highly desirable.

(10) The work of the American Standards Association and the federal Division of Simplified Practice has immensely facilitated the work of the trade associations. The ignorance of the existence of these bodies, or of the character of the functions they perform, would seem to be one of the major reasons for the failure of some trade associations to adopt standards.

(11) The extension of standards into new fields, and the more rapid expansion of trade association standardization where the work has already been started, would seem to require of the trade association the following:

(a) A permanent office and a paid secretariat.
(b) A definite time of meeting and a definite method of delegating authority.
(c) A program of education that would acquaint the membership with the meaning and uses of standardization.
(d) The establishment of working relationships with the American Standards Association and the Division of Simplified Practice, where their services may be used.
(e) An understanding of the extent to which standardization will or will not eliminate the small plant, or inhibit

the initiation of new and better designs and processes.

(f) An understanding of the extent to which standardization can be applied in the particular field in which the association is interested.

(g) The elimination of overlapping of trade association activities in the same field.

(h) The demonstration of how standardization can be used to strengthen trade-marks and brand names by changing the emphasis to essential characteristics.

(i) An understanding on the part of the membership that cooperation may be essential, and that it does not mean, of necessity, that "somebody is trying to run their business for them."

(j) A secretariat alive to what is going on in the entire field of trade association activity, and aware of the dangers of a provincial or too narrowly selfish outlook in the buying, producing and marketing of goods on a national or international scale.

CHAPTER VI

THE AMERICAN STANDARDS ASSOCIATION AND OTHER NATIONAL STANDARDIZING BODIES

NATIONAL standardization may be regarded as the third of four stages in the process of industrial standardization.[1] In the first stage, standardization is localized in the individual plant, or within the separate departments of the individual plant. In the second stage, it is conducted on a national or geographic basis by trade associations, or by technical societies interested in a particular field, and is restricted to a *particular* industry. In the third stage, standardization is worked out on a national basis in fields that affect more than a single industry. The central body serves as a clearing house for the establishment of national standards of interest to producers, distributors and consumers. In the fourth stage, standardization is carried out on an international scale.[2]

Twenty such national standardizing bodies were in existence at the close of the year 1928.[3] With the exception of the British Engineering Standards Association, organized in 1901, all these organizations were created during or since the World War. The Dutch body, the Centrall Normalisatie Bureau, was organized in 1916; the German, Deutscher Normenausschuss, in 1917; and the American Engineering Standards Committee in 1918.[4] Similar central standardizing bodies have been temporarily set up, or are in the process of being set up, in South Africa, Ireland, India, Peru and Cuba.

In a broad sense, the scope of the activities of these national standardizing bodies is the same. A glance at the

[1] "Yearbook, 1928," *op. cit.*, p. 9.

[2] See Chapter III of this volume for descriptive material on the first stage, Chapter IV and V for the second, and Chapter IX for the fourth.

[3] See Appendix C of this volume for a complete list of national standardizing bodies.

[4] Predecessor of the American Standards Association. See footnote, p. 19 of this volume.

yearbooks published by the American Standards Association, the Canadian Engineering Standards Association and the Deutscher Normenausschuss, or the numerous bulletins issued from time to time by the British Engineering Standards Association will show considerable activity in every branch of the steadily broadening standardization movement.

There is, however, considerable difference in emphasis in the work of the national standardizing bodies. The Deutscher Normenausschuss has engaged primarily in the working out of dimensional standards, grounded upon basic standards (Grundnormen) of length, mass, mathematical symbols, etc., which in turn rest upon careful fundamental scientific research. The other continental standardization bodies tend to follow the German example. This is particularly true of the new Russian Standards Committee, located at Moscow. The American Standards Association, on the other hand, has laid particular emphasis on the problem of bringing order out of the chaos of standards in actual use, in number and variety of which American industry undoubtedly leads all other countries, with the immediate object of early application to industrial processes. Along with this has gone considerable effort toward establishing national safety codes, and codes of good practice. This policy of expediency has been pursued to a considerable extent by the Canadian, Australian, Japanese, French and British standards organizations.

The procedure of these national standards bodies has, in general, been modeled upon that of the British Engineering Standards Association. In a sense, this might be said to be the most important feature of national standardization, as contrasted to other types. In America the object of the central organization is to provide a procedure by which national standards may be established. In other countries the central standards body deals with all aspects of producing and promulgating standards.

The central feature of this more or less common procedure is the technical or working committee. "The actual formulation of specifications and other forms of industrial standards, and the technical decisions involved, are in the hands of 'sectional committees,' which are designed to be true cross-

sections of the industrial groups concerned, each being made up primarily of accredited representatives of the various bodies interested."[1] The standardization work of the central body consists of the formation and use of sectional committees, and the ratification or rejection of their recommendations for "national standards." Standards once accepted are subject to revision by the same procedure.

Not all of the national standards bodies are incorporated. The American Standards Association has a carefully worked-out Constitution, Rules of Procedure and a set of By-Laws. The Deutscher Normenausschuss works without a constitution, a fixed set of rules of procedure or formal by-laws. Between these two extremes in organization are found the other national bodies.

Membership, the method of support, and the offices and duties of the paid personnel differ somewhat, but not in any significant degree. The trade associations have become the most important group in the actual standardization work of the American Standards Association. This is true in Germany and to a large extent in England. In Russia, Poland and Japan, where the standardization work is carried on as a government activity, the central body is a government organization.

The amount of publicity work done by the different national bodies varies considerably. In Germany, England, Czechoslovakia, and, to a lesser extent, in the United States and in Canada, publicity in the early stages of a standards project, during the process of securing a consensus of opinion and after the completion of the project is a very important part of the activity of the central body. The publication and sale of standards, particularly in Germany and England, accounts for a large percentage of the annual income of the national organizations.

The similarities of the national standards bodies in the scope of the work, methods of procedure, systems of organization and the relations of members to the central body enable one to gain a fairly accurate picture of the work of all of the bodies by examining closely the larger, more important organizations.

[1] "Yearbook, 1928," *op. cit.*, p. 25.

The American Standards Association[1]

The American Engineering Standards Committee was organized in 1918 by five technical societies, four of which were engineering societies: the American Society of Civil Engineers, the American Institute of Mining Engineers, the American Society of Mechanical Engineers, the American Institute of Electrical Engineers and the American Society for Testing Materials. The first meeting was held October 19, 1918. Later, upon invitation, the Departments of War, Navy, and Commerce designated representatives to serve on the Committee. In August, 1919, the constitution was broadened to permit the representation of other national bodies.[2] The procedure was revised in October, 1920, and again in 1928, when the name was changed to American Standards Association. This change to meet changing conditions involved, also, important changes in the constitution of the Association. Chart 7 shows the present organization of the American Standards Association.

The Association includes five classes of members.[3] Member-bodies, of which there are now thirty-seven, include nine

[1] The change of name from the American Engineering Standards Committee was due to two confusions arising under the old name. The question arose, "Just what is an *engineering* problem?" There seemed no way of answering the question to the satisfaction of all parties concerned. So, while the Association still restricts its activities almost entirely to purely technological standardization, the term "engineering" has been struck out of the name. The other confusion arose over the dual use of the term Committee to indicate not only the entire organization but also the Main Committee, analogous under the American Standards Association to the Standards Council.

[2] "Yearbook, 1928," *op. cit.*, p. 11.

[3] American Standards Association Constitution.

"Section C6. There shall be five classes of members: Member-Bodies, Honorary Members, Directors, Councilors, and Sustaining-Members, as defined in sections C7, C8, C9, C10 and C11.

"Section C7. Member-Bodies shall be organizations or groups of organizations of national scope, with which the ultimate general authority and responsibility for the policies and affairs of the Association shall lie.

"Section C8. Honorary Members may be elected as provided in the By-Laws.

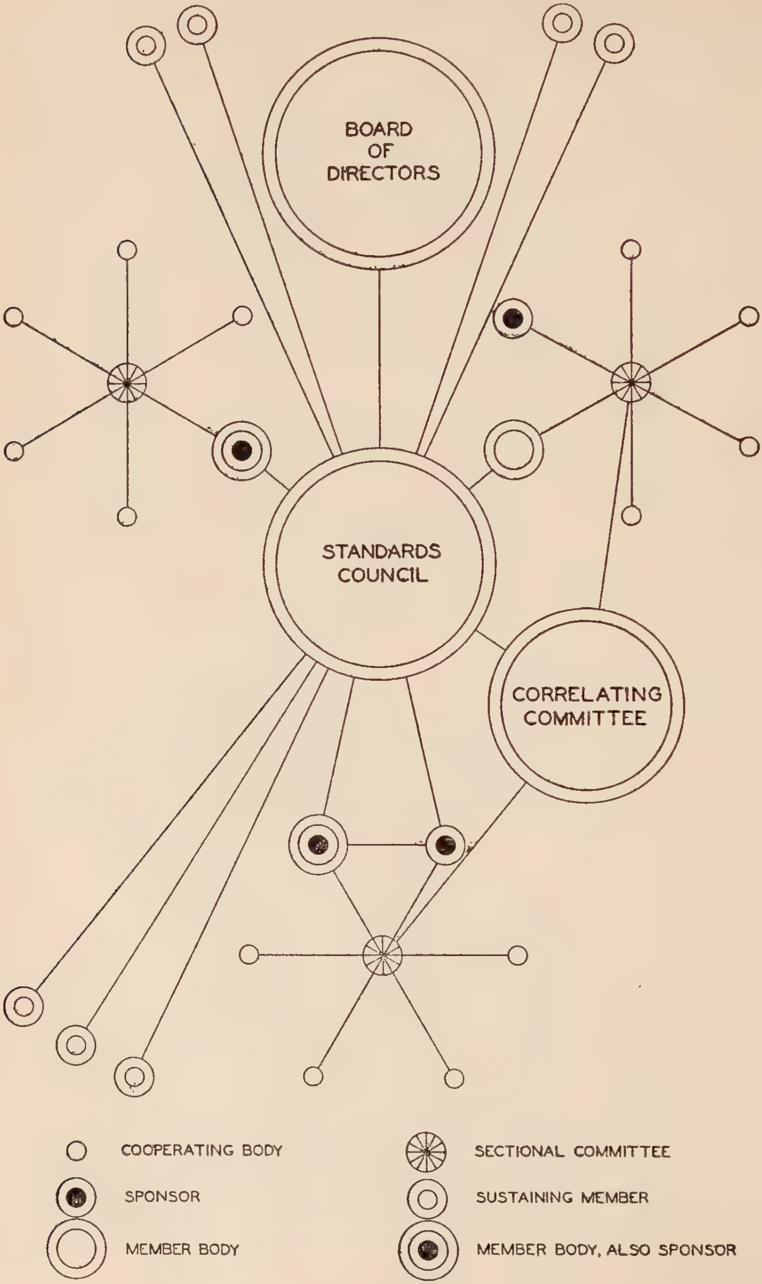
"Section C9. Directors shall be members of the Board of Directors, as hereinafter provided.

"Section C10. Councilors shall be members of the Standards Council, as hereinafter provided, upon which they shall be the representatives of the Member-Bodies appointing them.

"Section C11. Sustaining-Members shall be organizations, companies, or individuals interested in the work of the Association and subscribing to its support, as provided in the By-Laws."

CHART 7: AMERICAN STANDARDS ASSOCIATION, ORGANIZATION CHART

(Source: American Standards Association)



national engineering societies, twenty-one trade associations and seven departments of the Federal Government. Councilors are representatives of the Member-Bodies, each of which is limited to a maximum of three representatives. Honorary Members are elected by the Board of Directors. Sustaining-Members, or organizations interested in the standardization work of the Association and subscribing to its support, now number over 310. About 285 cooperating, non-member bodies are interested in the standardization work of the Association and are represented in its technical work. Approximately 200 of these are trade associations.

The Association is supported by membership dues and fees, the sale of standards and voluntary subscriptions. Each Member-Body pays annual dues of $500 for each representative it has on the Standards Council. Sustaining-Members pay annual subscriptions based either upon a fixed percentage of their total annual business or upon the aggregate market value of their corporate securities.

The Board of Directors, comprised of twelve business executives headed by the President, has charge of all general administrative, executive and financial functions of the Association. Election, upon nomination by selected Member-Bodies, is for a term of three years.

The Standards Council has charge of the selection of committees engaged in the investigation, formulation and drafting of standards, and passes upon standards "supported by a consensus, affirmatively expressed, of those substantially concerned with the standard."

The actual processes by which standards may be made "national" are four in number[1]: the Sectional Committee Method, the Existing Standards Method, the Proprietary Standard Method and the General Acceptance Method. These four procedures are graphically presented in Chart 8.

All but the last of these procedures calls for the selection of a Sponsor or of Joint-Sponsors "competent to vouch for the technical qualifications"[2] of the standard under question. Such Sponsors choose the sectional committee, furnish the incentive and the facilities for the prosecution of the work, turn in the completed report to the Standards

[1] "Yearbook, 1928," *op. cit.*, p. 68. [2] *Idem.*

Chart 8: American Standards Association, Procedure for the Development of American Standards

(Source: "Yearbook, 1928," *op. cit.*, pp. 12–13)

Sectional Committee Procedure

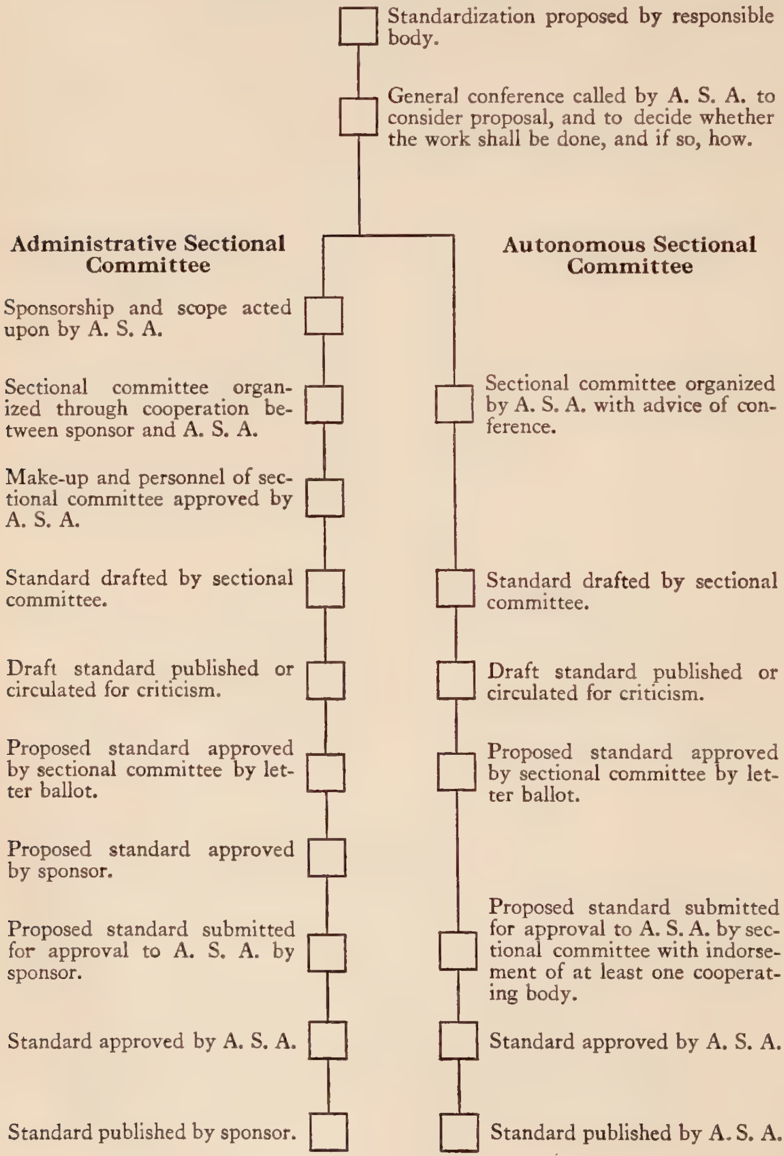


Chart 8: American Standards Association, Procedure for the Development of American Standards (*Continued*)

Approval of "Existing" and "Proprietary" Standards

An existing or a proprietary standard submitted to A. S. A. for approval by a responsible body.

Investigation of facts regarding consensus through A. S. A. agencies.

Standard approved by A. S. A.

Standard published.

Note: Revisions of approved "proprietary" standards are at the discretion of the sponsor. Revisions of approved "existing" standards are made by the sponsor or by the sectional committee to whose charge the standard has been consigned.

Development of a Standard by "General Acceptance"

Standardization proposed by responsible body.

Survey of field made and draft standard produced by working committee.

Draft standard considered by general conference.

Proposed standard presented to all groups concerned for their written acceptance.

Standard approved by A. S. A.

Standard published.

Council, and provide for the publication of the standards.

Under the Sectional Committee Method, work may proceed under the guidance and control of an Administrative Sponsor, or the committee may be autonomous. In the first case, the appointment of the sectional committee is made by the sponsor, subject to the approval of the Standards Council; in the second case, the Council sets up the committee. Approval of the appointments by the Council is based upon its criteria of what constitutes a body representative of all the interested parties, and the technical knowledge of the appointees. The Rules of Procedure specify very definitely the parties that must be included when the standards are of a commercial character (such as specifications, dimensional standards, etc.), or where Safety Codes are involved.[1]

The sectional committee is made up of accredited representatives of all bodies directly concerned with the project undergoing standardization. It may delegate parts of the work to sub-committees not of its own membership.

However made up, it is the duty of the committee to examine every angle of the issues at stake, to secure an adequate statement of the position of every group interested in the standard, to undertake if necessary a scientific investigation of technical facts, to compile its material into exhibits presentable to the sponsor, to draft a suitable standard, and, finally, to refer that standard to the sponsor society with a recommendation. The sponsor society or societies may, in turn, make an investigation following the completion of the sectional committee report, may refer to the sectional committee for additional information or for partial or complete reconsideration, and finally may make an independent recommendation to the Standards Council,

[1] American Standards Association Constitution, Procedure, Sec. 208. (b) "The membership of Sectional committees dealing with Safety Codes shall be classified as follows:

A. Manufacturers (Makers of equipment).
B. Employers (Purchasers, owners of the equipment).
C. Employees.
D. Governmental bodies having regulatory power or influence over the field in question.
E. Independent specialists, such as staff representatives of technical societies, consulting experts with no exclusive business affiliation, and educators.
F. Insurance representatives."

accompanied by all the relevant material collected by either or both bodies. The Standards Council then passes upon the standard. The procedure under the autonomous sectional committee is similar, except that this body reports directly to the Council.

The Existing Standards Method provides a procedure by which standards already in use may be submitted by a responsible body and put through the regular sectional committee procedure, or be approved by the Council, provided the Council is given reason to believe that "the standard is supported by the necessary consensus of those substantially concerned with its scope and provision."[1]

The Proprietary Standards Method provides a procedure by which proprietary standards, "which are formulated in the first instance and thereafter revised entirely under the auspices of Sponsor organizations,"[2] may be approved by the Council as national standards.

The General Acceptance Method,[3] which does not require a sponsor organization, is designed to facilitate the establishment as "national" of standards unlikely to arouse dispute as to their adequacy or desirability, and for which the organization of a sectional committee is unnecessary. A general conference of all interested groups undertakes a survey and makes the final recommendation to the Council.

Approval of the proposed standard by the Standards Council depends not upon a consideration of the adequacy or methods of treatment of the technical details but "the adequacy of representation of the various interests on the sectional committee and the procedure which has been followed."[4] The Council, before approval, must have ". . . satisfied itself that all organizations concerned have had an opportunity to participate in the work, that the work has been carried out under a procedure that has been regular,

[1] *Ibid.*, Sec. 301. [2] *Ibid.*, Sec. 401.

[3] *Ibid.*, Sec. 501. The General Acceptance Method is recognized as suitable for producing national standards by the sole means of a conference of those principally concerned, supplemented by a sufficiently large number of written acceptances of the conference recommendation from all of those substantially concerned with the scope and provisions of the recommendation.

[4] "Standards Yearbook, 1928," *op. cit.*, p. 15. In all cases where the word "Main Committee" is used, the new name, "Standards Council," has been substituted. The 1928 Yearbook came out before the reorganization of the society was complete.

open, and above board, and that the standard represents a real national consensus on what is best in American engineering and industrial practice, and hence that it either already does or may reasonably be expected to play a significant, if not a controlling, rôle in regard to the materials and processes in the industry concerned."[1] Standards may be approved as "American Standard," "American Tentative Standard" or "American Recommended Practice," or approval may be refused.[2] Any standard approved by the American Standards Association may be revised from time to time upon the request of a responsible body.

The work of the Standards Council is not, however, complete with the final approval of a standard.[3] Since the general objective of the Association "is to further the development and use of national industrial standards,"[4] the establishment of an information service and the securing of adequate publicity in technical journals, current periodicals in general circulation and newspapers are important functions.

Complete files of standards approved by foreign national standardization bodies, and a majority of the standards issued in this country by private firms,[5] trade associations, technical societies and the Federal Government are maintained by the Association. At the present time it has about 7,000 standards on file.

The Association issues a monthly *Sustaining Members Bulletin*, designed to give concise information on current standardization developments. Foreign materials on the subject of standardization are made available to the members by a staff engineer translator. The *Bulletin* "presents a great deal of this information in condensed, classified form, announcing new foreign standards for sale, giving excerpts from the foreign press bearing on engineering and trade problems of standardization interest, reviewing proposed and ap-

[1] *Idem.*, Oct. 11, 1928.

[2] By-Laws of the American Standards Association, Sec. 65: "The majority of the Standards Council required for action by letter ballot on a standard shall be:

For approval as 'American Standard'	90%
For approval as 'American Tentative Standard' or as 'American Recommended Practice'	75%
For withdrawal of approval	50%"

[3] The procedure for a standards project is shown in Appendix D, p. 279.

[4] "Yearbook, 1928," *op. cit.*, p. 11.

[5] *Ibid.*, p. 18.

proved American standards, and other developments in the American standardization field."[1] The Association now has on its staff an engineer engaged entirely in general publicity work, the writing of news releases to the daily papers, the preparation of materials of news value for the technical and trade press, etc. Through its Yearbook and the occasional publications of the members of its staff, an attempt is made to clarify the issues involved in the Association's work.

Close cooperative relations with foreign national standards bodies are maintained through constant interchange of information, specifications, codes, practices, etc., and through the international conferences of secretaries. Out of these conferences has come the suggestion for the establishment of an International Standards Association, toward which the first steps of organization have already been taken.[2] The American Standards Association cooperates with the International Electrotechnical Commission, the International Commission of Illumination, the International Committee of Weights and Measures and other international organizations interested in standards. It was represented at the Pan-American Conference on Standardization held in 1924, and again in 1925.

The real accomplishments of the American Standards Association, except in their proximate significance, are difficult to gage. Of the 275 projects undertaken, the Association had completed 111 at the end of 1928.[3] A slightly differ-

[1] *Idem.*

[2] See p. 153 of this volume.

[3] "Yearbook, 1928," *op. cit.*, p. 7. The status of American Standards Association projects in the major fields of work in January, 1928, is indicated by the following table:

Group	Number of Projects	Projects Approved
Civil Engineering and Building Trades	34	14
Mechanical	72	27
Electrical	50	17
Automotive	5	4
Transportation	10	9
Naval Architecture and Marine Engineering—Shipbuilding	1	..
Ferrous Metallurgy	4	3
Non-Ferrous Metallurgy	10	6
Chemical	8	6
Textile	2	..
Mining	19	7
Wood	5	4
Pulp and Paper	2	1
Miscellaneous	53	13
Total	275	111

ent classification than that offered by the Yearbook would show the most thorough work in the field of safety codes and in the electrical industry. This emphasis is due on the one hand to the urgency and the general agreement concerning the need for safety codes, and on the other to the existence of strong trade associations actively interested in the electrical standardization field. A further reason for success in these fields may be the effectiveness of the "correlating committees,"[1] of which the American Standards Association now has three—the Mining Standardization Correlating Committee, the Safety Code Correlating Committee and the Electrical Advisory Committee. Such a committee is now in the process of organization in the mechanical field.

That the Association enjoys the confidence and support of business executives and technicians is attested by the growing number of national trade associations and technical societies, and the large number of private firms that are actively cooperating with the organization. The establishment of the Commercial Standards Unit and the growing tendency on the part of the Federal Government to enter the field of industrial standardization have brought to the front the question of whether or not this work should be done by the Government, or by industry acting through its own agency—the American Standards Association. Opinion seems to be swinging in favor of increasing the power and the scope of the American Standards Association and of resisting encroachment of the Federal Government upon the industrial standardization field. The recent reorganization of the American Standards Association was the first important step in that direction.

There are no data available, except in sections of particular industries, on the extent to which A. S. A. standards are in use. The Safety Codes appear to have became rather generally adopted. They have in many cases been made the basis for state and municipal safety legislation and for laws

[1] *Ibid.*, p. 16. "Such committees, acting in an advisory capacity, suggest subjects for standardization, recommend sponsors, define and limit the scope of projects, adjust conflicts, clear up ambiguities, follow up and expedite work in progress in the development of standards, and report from time to time upon progress made within their field of activities; in short, they correlate the work of the group of sectional committees with which they are in contact and with whose problems they are familiar."

relating to accident insurance. The close cooperation of the larger trade associations has secured the immediate and widespread adoption of some of the American Standards.

The British Engineering Standards Association

The British Engineering Standards Association was founded in 1901 by five engineering societies: the Institution of Civil Engineers, the Institution of Mechanical Engineers, the Institution of Naval Architects, the Iron and Steel Institute and the Institution of Electrical Engineers. The Association was reorganized and incorporated by act of Parliament in 1918, as an organization having as its chief objects the following:

"(A) To coordinate the efforts of producers and users for the improvement and standardization of engineering materials, and for this purpose to take over and continue the work which has been carried on since 1901 by the Engineering Standards Committee.

"(B) To adopt such measures and take such steps, and do all such things as may in the opinion of the Main Committee be conducive to the promotion of cordial relations between members and other persons interested in the objects of the Association.

"(C) To prepare, and promote the general adoption of standards in connection with engineering structures, materials and other matters and things, and from time to time revise, alter and amend the same.

"(D) To register in the name of the Association the Mark which was originally registered for the Engineering Standards Committee in 1903, and to prove, and affix or license the affixing of such Mark or other proof, letter or device, to certain engineering materials, and to enforce and protect the use of such Mark, proof, letter or device and to oppose any proceedings or applications which may seem calculated, directly or indirectly, to prejudice the interests of the Association.

"(E) To obtain any Royal Charter, provisional order or Act of Parliament to enable the Association to carry its objects or any of them, into effect.

"(F) To establish, in foreign countries and British Dominions overseas, local Committees to further the objects of the Association.[1]"

Membership of the British Engineering Standards Association is open to professional engineers, industrial firms and business men connected with the engineering and allied industries. The engineers and business men may be affil-

[1] British Engineering Standards Association, "Thirteenth Report of Work Accomplished," 1919, pp. 7–8.

iated directly with private firms, engineering societies, trade associations or the British Government. The present membership numbers something over 2,000. The Association is financed by membership fees, subscribers, government aid, and the sale of its publications and standards. Like the American Standards Association, the British Engineering Standards Association does not initiate standards. Initiation comes from a responsible body and the Association provides a mechanism whereby the standards can be given the status of B.E.S.A. standards. The sole authority is vested in the Main Committee, consisting of thirty members, twenty-one of whom are nominated by the leading technical institutions, five coöpted by the nominated members and three ex-officio. The constitution of the Association provides for rotation of office of the members.[1] The Main Committee, most of whose duties relating to the drafting of standards are analogous to those performed by the Standards Council of the American Standards Association, decides whether a project shall be entered upon,[2] forms the Sectional Committee in charge of the actual drafting of the standard and approves of standards submitted.

The Sectional Committee, except for composition,[3] occupies a position in the British Engineering Standards Association analogous to that of the Sponsor in the American Standards Association procedure. It decides "the broad lines upon which the Specifications shall be drawn up, leaving the detailed work of drafting to the Sub-Committee."[4] The preparatory work is done by Panels, or special committees made up from the Sub-Committees of the Sectional Committee. Panel meetings can be held at any designated place in the country at the desire of the members. Drafts of standards are submitted first to the Sub-Committee, then to

[1] *Ibid.*, "Its Aims and Objects," p. 3.

[2] *Ibid.*, p. 4. "Before appointing a committee to study any subject, the Main Committee assures itself by a representative conference of all interests concerned that there is a consensus of opinion favorable to the proposed work being undertaken, and that it is to fill a recognized need."

[3] "Thirteenth Report," *op cit.*, p. 20. "The Sectional Committees consist of representatives of the various Government Departments, of Consulting Engineers, Manufacturers, Contractors and Users, and representatives of the Technical Societies and Trade Associations interested or affected by the subjects under consideration."

[4] *Idem.*

the Sectional Committee. Approval makes of the specification a national British Engineering Standards Association standard. The Association is principally concerned with the drawing of standard specifications.[1] Some work is done in the field of standardization of nomenclature, but relatively little in the field of Safety Codes and Codes of Good Practice, which are still governmental matters everywhere in Europe. Its most important work has been done in the electrical and mechanical fields.

The British have collected and published, from time to time, surveys designed to show the extent to which B.E.S.A. standards are in use. Where standards have been formulated that relate to the work of various government departments, particularly the Admiralty, they have secured immediate adoption. Association specifications, of which it publishes and circulates about 60,000 per year, have secured wide industrial use. In 1919 it was estimated that "60 per cent of the material used in the manufacture of railway rolling stock in Great Britain, and practically the whole of the material employed in the construction of railway rolling stock in India, is made in accordance with the British Standard Specifications."[2] It is estimated that of the 3,000,000 ton output of Portland cement in Great Britain in 1913, 95 per cent was manufactured according to British Engineering Standards Association specifications.

The British Engineering Standards Association maintains very close relations with the Dominion standards associations of Canada, Australia, South Africa and India. These bodies are very similar in organization and procedure to the British Engineering Standards Association, and use British Engineering Standards Association standards as a basis for their own work or merely republish them without alteration. The British Association is also in close contact with several international standardization organizations, such as the International Electrotechnical Committee and the International Aircraft Standards Commission. The British Engineering Standards Association Electrical Com-

[1] See indexed list, "British Standard Specifications and Reports," London, January, 1928.

[2] "Thirteenth Report," *op. cit.*, pp. 20–23. This section of the report gives a good summary of acceptance of B.E.S.A. standards in British industry.

mittee is the British representative of the International Electrotechnical Committee.

Deutscher Normenausschuss

The Normenausschuss der Deutschen Industrie (German Industrial Standards Committee) was organized in 1917 by the Verein deutscher Ingenieure (Society of German Engineers) as the successor to the Normalienausschuss für den allgemeinen Maschinenbau (Standards Committee for the General Machine Industry), formed in the early months of 1917. The Normalienausschuss für den allgemeinen Maschinenbau was, in turn, the successor to the Königliches Fabrikationsbüro (Royal Production Bureau), whose task was to unify, integrate and coordinate the task of supplying the needs of the army in the prosecution of the war.

The rapid expansion of the activities of the Normenausschuss der Deutschen Industrie into fields not specifically confined to the German conception of industrial processes led to a reorganization in 1926. The reorganization involved the incorporation of the Committee, the establishment of the body under a formal constitution, and the changing of the name to Deutscher Normenausschuss (German Standards Committee).[1]

The structure of the Deutscher Normenausschuss as set up in its charter is without significance as regards its standardization work,[2] for in actual practice the Committee is an exceedingly flexible organization, operating without fixed rules or procedure, constitutional limitations or formal bylaws. This flexible organization, largely the product of its guiding genius, Dr. H. Hellmich, has been exceedingly successful in introducing standards into German industry.

Membership in the Deutscher Normenausschuss is open to Government departments and officials, scientists and engineers, business men representing private firms or trade

[1] See "DIN, Die Deutsche Normung, Stand der Arbeiten, 1927," Berlin, 1927, pp. 6–11; "Jahresbericht (Yearbook) 1927," of the Reichskuratorium für Wirtschaftlichkeit, Berlin, pp. 18–19; H. Hinnenthal, "Die Deutsche Rationalisierungsbewegung und das Reichskuratorium für Wirtschaftlichkeit," Berlin, 1927, pp. 12–15.

[2] "DIN, Die Deutsche Normung, Stand der Arbeiten, 1927," *op. cit.*, p. 8. Also, "Deutscher Normenausschuss, Satzung," Berlin, Oct. 29, 1927.

associations, and general interest groups such as technical schools and universities. The Normenausschuss is supported by membership dues, private donations, federal grants—especially those received from the Reichskuratorium für Wirtschaftlichkeit (Federal Board for National Economy)—returns from the sale of its standard sheets (Normblätter) and handbooks, and from license fees and sales of file cards advertising firms manufacturing standard products. The Normenausschuss is striving to become a self-supporting organization by the sale of its standard sheets, etc.

The formal organization of the Normenausschuss includes an executive committee of fifteen members, in whose hands the main executive and administrative duties are officially placed. This committee has control of all the general standardization work, decides what projects shall be taken up for consideration as German standards, selects the special working-committees in actual charge of the drafting and publication of the standards, etc.

German industrial standards are of two kinds; standards having a general significance, like basic standards governing units, symbols, etc.; and special industry standards (Fachnormen). The first are standards that affect two or more industries, such as basic standards of length, size, design, screws and screw threads; the second relate to standards within particular industries.

Customarily, standards are first worked out in the special industries. A working committee (Arbeitsausschuss) of the special industry committee (Fachnormenausschuss), representing producers, consumers, commercial interests, governmental authorities and scientists or skilled technicians, drafts the standard. If it affects more than one industry, it may then go to the central body for the purpose of coordination. Whether a standard becomes national or remains a special industry standard, the completed project is given the status of a DIN standard[1] and is published on a

[1] Under the Normenausschuss der Deutschen Industrie, this symbol represented an abbreviation of Deutsche Industrie Normen (German Industrial Standards); the symbol has been retained under the Deutscher Normenausschuss but now indicates Das Ist Norm (That Is Standard). This symbol has a legal status similar to that of a trade-mark, and can be used by manufacturers only with permission of the Deutscher Normenausschuss. Unauthorized users of the symbol may be prosecuted.

standard sheet (Normblatt) for circulation. Charts 9 and 10, respectively, show the organization of the German Standards Committee and the process for the development of a standard sheet.

The 1927 Yearbook states that 1,950 different standard sheets have been published and distributed to members, private firms, trade associations, government departments, engineering societies, technical schools, universities, and to interested foreign individuals or organizations. About 100,000 of these standard sheets are sold each month.

The activities of the Deutscher Normenausschuss are, in some respects, of broader scope and are carried out in a more thorough manner than those of any other national standardizing body. The staff of the Normenausschuss in 1927 numbered sixty persons, of whom fifteen were engineers.[1] Besides the administrative work connected with the selecting and drafting of standards and the publication of the standard sheets, the Normenausschuss carries on extensive publicity work by means of articles for the technical journals, the public press and current periodicals, the publication of a yearbook and of a section of *Betrieb*, a magazine published by the Verein deutscher Ingenieure and dealing with questions of production and efficiency engineering, etc. All proposed standards are published twice in this magazine: first as a tentative proposal of the working committee (Entwurf),[2] and second, as an official proposal with the authority of the Executive Committee (Vorstandsvorlage). Considerable explanatory matter is added.[3]

The Normenausschuss cooperates actively with the Deutscher Ausschuss für Technisches Schulwesen[4] (German Committee for Technical Education). This Committee distributes DIN standards and provides lantern slides showing details of good construction, the nature and requirements of certain basic standards, etc., free to teachers and professors in technical schools, universities, high schools and

[1] This figure compares favorably with the American Standards Association, which has a staff of seventeen, three of whom are engineers.

[2] This proposal is sometimes published again in revised form.

[3] *Main Committee Bulletin*, *op. cit.*, No. 60.

[4] See collection of bulletins appearing under cover, "Deutscher Ausschuss für Technisches Schulwesen."

Chart 9: German Standards Committee, Organization Chart

(Source: "DIN, Die Deutsche Normung," p. 6.)

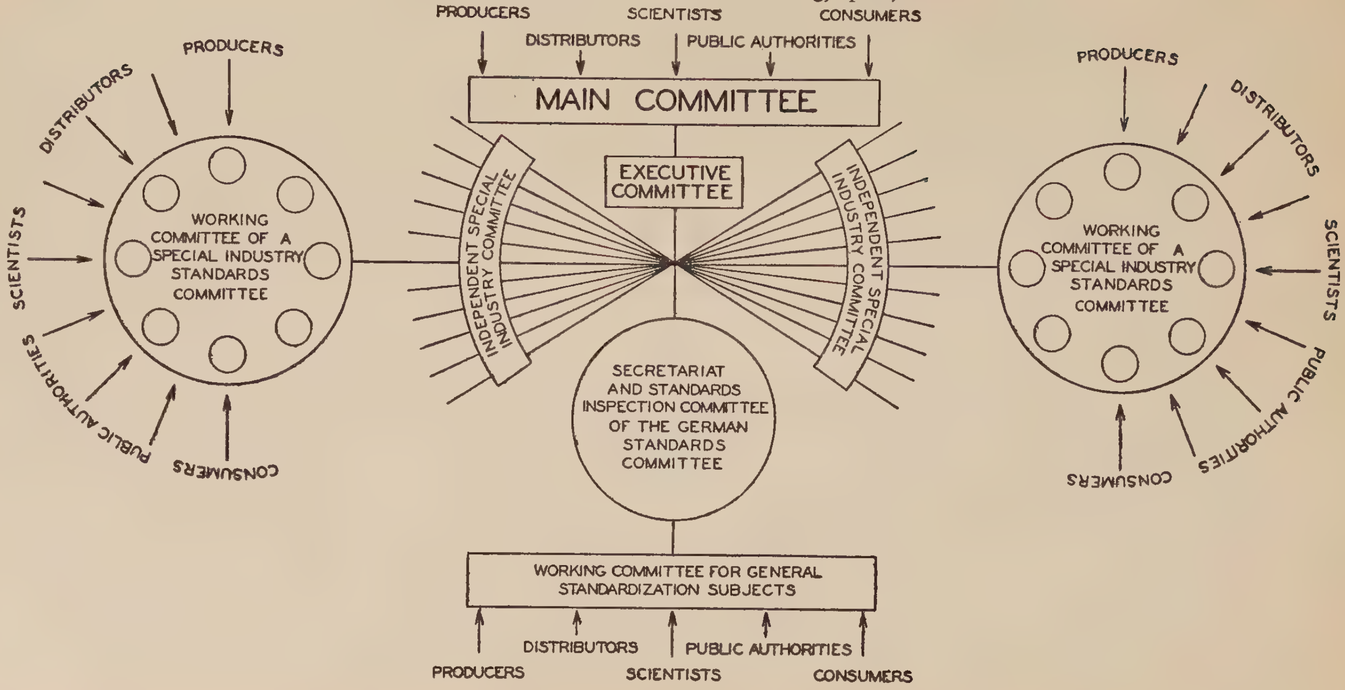
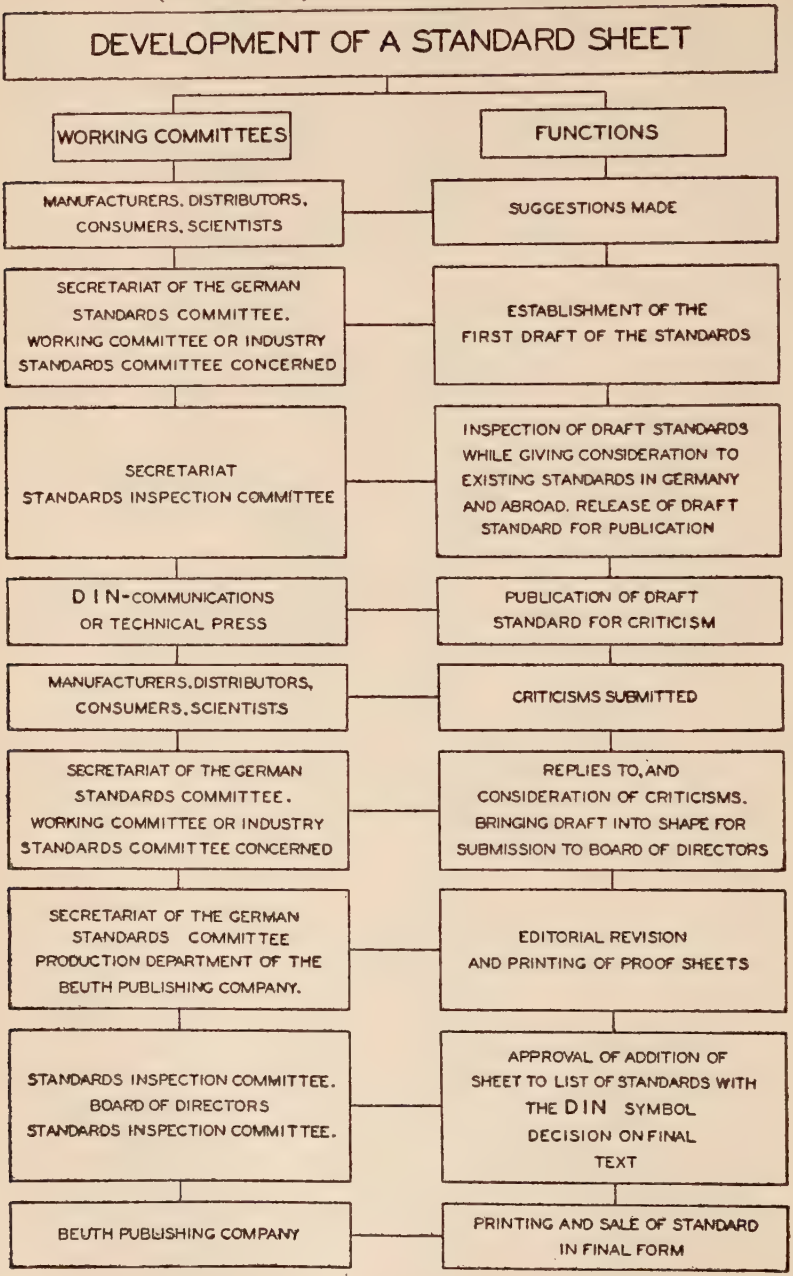


CHART 10: GERMAN STANDARDS COMMITTEE, STANDARDIZATION PROCEDURE

(Source: "DIN, Die Deutsche Normung," p. 21)



even grammar schools. Thousands of DIN standard sheets and handbooks explaining standards practice are sold annually to students in the technical schools. The Committee also cooperates actively with the Verband der Deutschen Berufsgenossenschaften (Federation of German Mutual Accident Insurance Companies) in its program of popularizing the use of recognized safety practices and devices.

As was pointed out before, German standardization work has been characterized from the first by its emphasis on dimensional standards and the attempt to build the structure of its standards upon a firm scientific foundation. This has involved close liaison work, in many cases, with the Physikalisch-Technische Reichsanstalt (National Physical Technical Institute), and constant emphasis on research work. Several firms, working out their own company standards (Fabriknormen), maintain research workers at the offices of the Normenausschuss and at the Reichsanstalt.

However, this emphasis on dimensional standards has not prevented work in fields not yet considered subject to standardization technique in other countries. Simplification, which has been carried on in the United States as a movement separate from standardization, is in Germany an integral part of the whole process. The Normenausschuss has standardized, or is standardizing, a wide range of materials generally unnoticed by standards bodies, such as doors and windows, plumbing equipment, pots and pans (particularly aluminum ware), hospital beds, typewriter elements and accessories, such as ribbons and spools, etc. Much of this work has been carried on with the active cooperation of national organizations of ultimate consumers and labor unions, groups that are not effectively represented in the standardization movement in the United States.[1] Closely connected with this work has been active participation in the broader rationalization movement.

No accurate summary of the extent to which DIN standards are used in industrial processes has been made. Perhaps the program is moving too rapidly for any such survey

[1] Exceptions are to be found to this generalization in three recent American Standards Association projects: those dealing with sheeting and refrigerators, in which representatives of ultimate consumers were invited to share, and a building safety code, in which labor representatives are included.

to be significant. A recent publication of the Normenausschuss gives an interesting general recapitulation of the accomplishments of the Committee since its inception in 1917.[1] From the comments made by the great industrial leaders, the scattered data in the Committee's numerous publications, and the number of standards sold, it would appear that standardization is an exceedingly popular movement in Germany, and that industry is making widespread and consistent use of the standards thus far established.

Other National Standardizing Bodies

Germany has been the leader in the standardization movement on the continent, as England has been in her own dominions. Many of the German standards have been adopted in whole, or with certain modifications, by the Czechoslovakian, Swiss, Dutch, Austrian, Hungarian, Scandinavian, Italian, Russian, Polish and Belgian standards committees. Important liaison work has been done by these bodies and the Normenausschuss.

Perhaps the most active of the newer European standardizing bodies are those located in Czechoslovakia and in Russia. The Czechoslovak Society for Standardization, organized in 1922 by twelve leading engineering and iron works, had sixty-nine members at the end of 1927.[2] Membership is open only to industrial firms and not to individuals. About 300 standards have been worked out to date. Several of these have been issued in book form, printed in both German and Czech. Approximately sixty standards are now in the course of preparation.

The Russian Committee, organized in 1925, has already completed about 200 standards, and 3,000 others are in the process of being worked out.[3] The committee had funds to the amount of 520,000 rubles (about $255,000) for the current year 1926–1927.[4] The Standards Committee publishes

[1] "DIN, 1917–1927," *op. cit.*

[2] *Bulletin of the International Management Institute*, *op. cit.*, January, 1928.

[3] Z. Papernoff, "New Activities of the Standards Committee under the Council for Labor and Defence," Moscow, 1928.

[4] This budget compares favorably with that of the American Standards Association, which in 1927 spent $61,267.16. "Yearbook, 1928," *op. cit.*

a magazine solely devoted to the subject of standardization. All approved standards are published in this magazine.[1] A group of ten Russian engineers are maintained in Berlin to translate German standards and others of use to the Russian Committee. The Committee has standardized such products as office furniture, cigarettes, soap, cotton seed oil, benzine and other chemicals in common use, in addition to conducting the usual type of engineering standardization work.

The Canadian Engineering Standards Association and the Australian Commonwealth Engineering Standards Association have been the most active of the Dominion standardizing bodies. Their work and method of procedure, which are largely modeled after those of the American Standards Association, have been quite successful, particularly in the electric and construction industries.[2] The Association publishes a yearbook and has done important liaison work with the American Standards Association and the British Engineering Standards Association.

The Japanese Engineering Standards Committee has been carrying on important standardization work in ferrous and non-ferrous metallurgy, and in the mechanical, electrical and construction industries. Since its organization in 1920, twenty-six standards have been completed and forty-seven are under consideration.[3] The Kogakkai (Engineering Society of Japan) has recently called a "World Engineering Congress," to convene in October, 1929.[4] The agenda give a prominent place to the subject of engineering standardization.[5]

[1] Standards Committee of the Council for Labor and Defence, "The Activities of the Standards Committee," Moscow, 1928, p. 7.

[2] Canadian Engineering Standards Association, "Yearbook, 1928," Ottawa.

[3] Department of Commerce and Industry, "Outline of Engineering Standardization in Japan," Tokio, March, 1926.

[4] World Engineering Congress, "Preliminary Announcement," Tokio, August, 1927.

[5] *Ibid.*, "Technical Programme of the World Engineering Congress," Tokio, 1927, p. 1.

CHAPTER VII

THE NATIONAL BUREAU OF STANDARDS

OCCUPYING a position parallel to the national standardizing organizations discussed in the previous chapter, and highly significant in the development of their work, are certain central governmental standards bodies. The National Bureau of Standards maintained by the United States Government is probably the most important of the governmental standardizing bodies, whether one have in mind standardization work in other departments of the Federal Government or the accomplishments of similar organizations in other countries. The most important bodies of the latter group are the National Physical Laboratory in Great Britain and the Physikalische-Technisch Reichsanstalt in Germany.

The Bureau of Standards was organized in 1901 as the successor of the Office of Standard Weights and Measures, a part of the Department of Treasury, to carry on the following functions as specified in the bill:

"(1) Custody of the standards.
"(2) Comparison of the standards used in scientific investigations, engineering, manufacturing, commercial, and educational institutions with the standards adopted or recognized by the government.
"(3) The construction, when necessary, of standards, their multiples and subdivisions.
"(4) The testing and calibration of standard measuring apparatus.
"(5) The solution of problems which arise in connection with standards.
"(6) The determination of physical constants and the properties of materials when such data are of great importance and not to be obtained of sufficient accuracy elsewhere."[1]

Subsequent legislation and discretionary enlargement of scope have increased these activities considerably. The development of cooperation with industry on a large scale during and following the World War, early and aggressive

[1] Institute for Government Research, "The Bureau of Standards," Service Monograph No. 35, Baltimore, 1925, p. 39. Readers interested in a more thorough treatment of the work of the Bureau of Standards will find in this monograph a complete discussion.

leadership in the safety code movement, the creation of the Division of Simplified Practice, and finally, of the Commercial Standards Unit, the development of the Certification program, and cooperative work with the inter-departmental Federal Specifications Board have made of the Bureau of Standards a powerful and significant force in the standardization movement in this country.

The Bureau of Standards was transferred from the Department of the Treasury to the Department of Commerce and Labor upon the creation of the latter in 1903 and was established in its present quarters in 1905. Since that time the expansion of the Bureau's work has called for a steadily increasing plant. The expenses for the expansion and all salaries and upkeep are met by special appropriations by Congress. Fees charged for the testing of commercial products are designed to cover merely the cost of the tests made. The staff consists of a Director, an administrative library and office staff, and the research chiefs, assistants and laboratory employees. A research associate plan permits industrial associations or groups to place qualified men at the Bureau for intensive study of selected problems approved by the Director of the National Bureau of Standards. These men utilize the laboratory facilities and equipment and have the same status as other Bureau employees, except that their salaries are paid by the supporting group or association.[1]

Scope of the Bureau's Standardization Work

For the purposes of this study, the activities of the National Bureau of Standards can be classified as follows:

(1) Basic scientific research preparatory to the establishment of reference and working standards and their conversion ratios into "natural" standards, or Standard Constants.[2] This work involves much pure scientific research

[1] "Standards Yearbook, 1928," *op. cit.*, p. 119.

[2] "Mechanical equivalent of heat, light, electricity, and gravitation; specific densities; viscosities; melting and boiling points; heat capacity; heats of combustion; velocity of propagation of light; conductivities of materials to heat and light; electrochemical equivalents and atomic weights; and many similar magnitudes determined experimentally with maximum precisions and referred to fundamental standards of measure." National Bureau of Standards, Circular No. 1, 2nd Edition, Washington, 1925, p. 83.

in fields such as the ionic theory and atomic structure with the object in mind of discovering the properties of well-known and new materials.

(2) Research of immediate value to industry, such as standard methods of technical analysis, testing of building materials for fire resistance properties and capacity to endure the various stresses and strains imposed by different types of buildings and structures, etc.

(3) The drawing of specifications and the testing of materials bought under specifications for the Federal Government. Acting as technical and scientific adviser on specifications work to other government departments, bureaus and divisions, and to states and municipalities.

(4) The promotion of the use of standards in industry. This work is carried on by placing the equipment of the Bureau of Standards at the disposal of research workers maintained by trade associations and private companies, and by the publication of a yearbook, series of bulletins and miscellaneous documents designed to acquaint industry and the general public with current developments in the fields of standardization and the work of the Bureau of Standards, and to increase the sphere of usefulness of the Government's work in standardization. Formal liaison work with trade associations, engineering societies and the American Standards Association is carried on through the following mechanisms:

(a) The Division of Simplified Practice, which is concerned with the elimination of "immaterial" and excess variety of products, and the establishment of simplified practice recommendations.

(b) The Commercial Standards Unit, which is attempting to promulgate certain national "Commercial Standards" by the use of a procedure somewhat similar to that used by the American Standards Association, with the expectation that such standards will possess an analogous status to those promulgated by that body.

(c) The Certification Plan, by way of which it is hoped to bring certain nationally recognized specifications, principally certain government "master specifications," into general commercial use throughout the country.

(d) The American Marine Standards Committee, which drafts standards of interest to the marine industries.

(e) The Central Committee on Lumber Standards, which drafts lumber standards.

Relation of the Bureau's Standardization Work to Industry

The Bureau of Standards was actively engaged in carrying on work of direct value to industry long before the World War. In 1907 it undertook, at the request of the American Foundrymen's Association and the Association of American Steel Manufacturers, ". . . the analysis and distribution of standard steel and iron samples which are used by these industries to standardize and check their own analyses from time to time."[1] In 1910, at the invitation of the American Mining Congress, the Bureau made a study of the standardization of electric machines and electric practice in mines.[2] In 1911 it completed a survey of trade weights and measures in the United States (omitting the states of Arkansas and Oklahoma).[3]

The War, however, represented a sharp break in the Bureau's activities. It called for a sudden expansion of the Bureau's work into a large number of fields hitherto untouched by Government standards. The mere enumeration of the important standardization work carried on by the Bureau during this period would occupy many pages. The significance of the war activities of the Bureau, however, is largely due to the fact that post-war conditions called for the continuation of work begun during the War, and for the rapid extension of the standardizing process into so many industries where standardization had been previously almost entirely unknown.

The War work of the Bureau involved not only the development of national standards for securing interchangeability of war apparatus, but also research leading to the

[1] *Ibid.*, p. 45.

[2] *Ibid.*, p. 47.

[3] *Ibid.*, p. 50. "During the two years of the investigation 8,650 scales were tested, of which 42 per cent were found to be incorrect; 10,929 weights were tested, of which 20 per cent were incorrect; 6,088 dry and liquid measures were tested, of which 33 per cent were incorrect."

utilization of new supplies of materials, devices and instruments; the perfecting of processes of manufacture, formerly held as foreign trade secrets or as private monopolies in this country, etc. Important examples of this type of work were the development of a tanning process for shark skins, a method of making good paper from linters, a satisfactory process for making optical glass (formerly almost completely monopolized by Germany), investigations into the process of manufacturing suitable fast dyes, the development of a vast number of devices, tools and instruments for use in the army and navy, etc.

After the War, the safety code work conducted by the Bureau was brought under the procedure of the American Standards Association. The completion of the new industrial laboratory in 1919 afforded industry a well-equipped laboratory for enlarged scientific work in chemistry, light, heat, and electricity. The growing use made of the facilities of this laboratory, and related work in other of the Bureau's laboratories by research associates maintained by trade associations, attests the importance being attached by those organizations to fundamental research of this nature.

The Division of Simplified Practice

The Division of Simplified Practice was organized in 1921, following the publication of the report of the Federated Engineering Societies, "Waste in Industry." Broadly speaking, its function is the elimination of unnecessary and "immaterial" diversity in styles, sizes, types and other varieties of manufactured products.

The working out of a "simplified practice" recommendation and the application of the standards to industrial use involve "four fundamental steps. . . . First, a comprehensive survey of the normal demand for existing variety; second, a sound and conservative elimination of non-essential items, planned with a proper consideration for the needs of all groups affected; third, enlisting the active support of producers, distributors and consumers; and fourth, maintaining interest and adherence by periodically revising the program to keep it abreast of current conditions and sales

trends."[1] In all cases the decisive factors are sales data and sales policies, not scientifically correct or "best" standards.

The first step in this simplification procedure is conducted by a "Simplification Committee" representative of the interested manufacturers, which drafts recommendations later submitted to representative industries. This Committee holds preliminary hearings, calls a general conference of the industry representing producers, distributors and consumers, and presents to this conference the agenda that it has drafted following its preliminary survey. This conference then appoints a Standing Committee, representing the three groups above, whose duty it is to conduct the real survey of varieties, select certain sizes, shapes or styles for Recommended Practice, secure acceptance of the recommendation of the industry, etc. The various steps in the Simplified Practice procedure are shown in Chart 11.

The successful completion of a survey and the selection of the varieties most widely used and most generally satisfactory led to the publication of a "Simplified Practice Recommendation," which includes the recommendation, the list of acceptors, a history of the project, a statement of the duties of the standing committee and a copy of the acceptance form. Seventy-nine such Simplified Practice Recommendations had been completed by the close of 1927.[2] Several of these recommendations have gone through a number of editions.

The Commercial Standards Unit

In September, 1927, the Commercial Standards Unit was set up as a separate division in the Bureau of Standards, to provide a procedure for establishing as "commercial standards" such nationally recognized specifications as are fully indorsed by the industries concerned.[3]

The procedure set up is similar in most respects to that used in the establishment of Simplified Practice Recom-

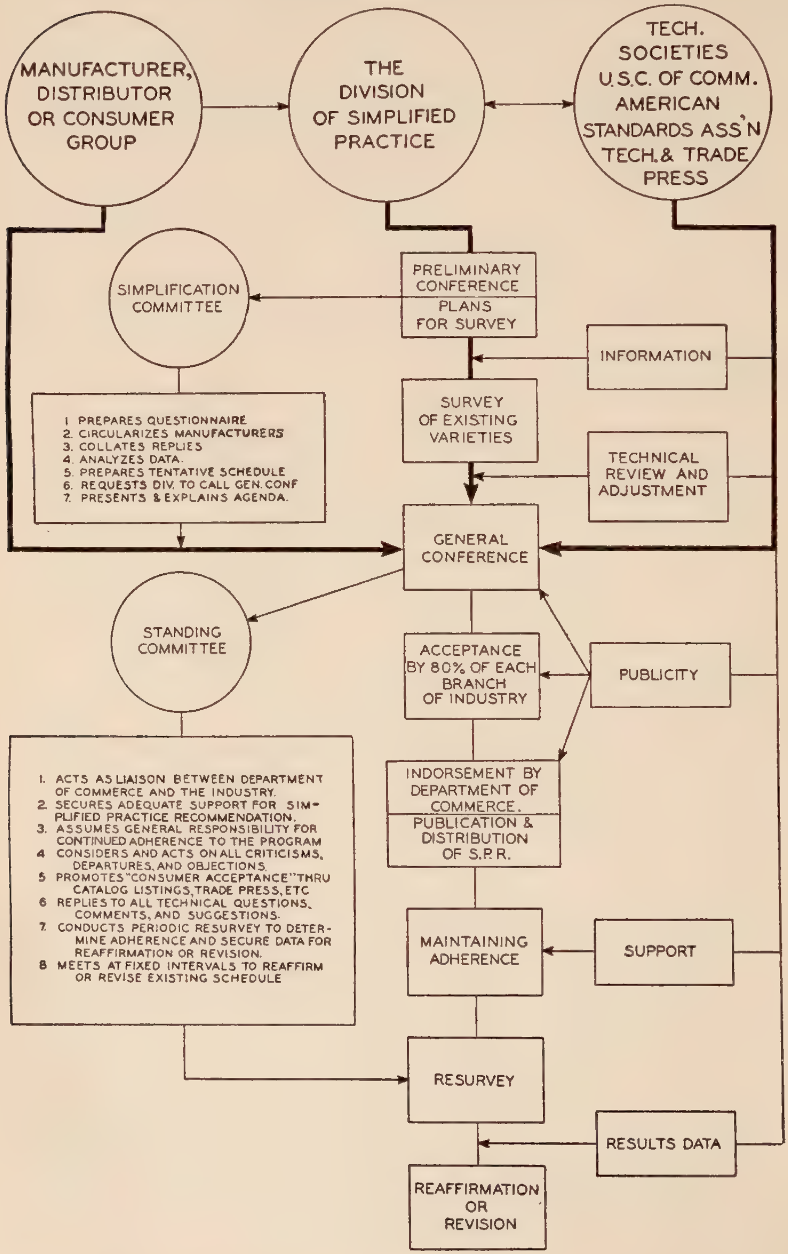
[1] Division of Simplified Practice, "Duties of Standing Committees," Washington, July 15, 1927, p. 4.

[2] See Appendix E of this volume for a list of Simplified Practice Recommendations as of Aug. 1, 1928.

[3] "Standards Yearbook, 1928," *op. cit.*, pp. 125–126.

CHART 11: DIVISION OF SIMPLIFIED PRACTICE, COOPERATIVE DEVELOPMENT OF A SIMPLIFIED PRACTICE RECOMMENDATION

(Source: Bureau of Standards, "Simplified Practice, What It Is and What It Offers," p. 3.)



mendations,[1] except for a technical review by the Bureau of Standards. "The chief mission is promotional in character to provide support for a specification or a standard which an industry and its related groups may want to promulgate on a nation-wide or a world-wide basis; to determine its eligibility for promulgation; to publish and broadcast it in the event the prerequisites, including a satisfactory majority of signed acceptances, have been met; to facilitate the application of the certification plan for the assurance and convenience of the small purchaser; to arrange a forum in cooperation with the Bureau of Foreign and Domestic Commerce for the selection and translation of specifications in the promotion of foreign commerce, and to provide a means for controlled periodical audits of adherence."[2]

A report of the Planning Committee in February, 1928,[3] listed nine projects on hand as the result of requests for the establishment of Commercial Standards. Three projects have been completed to date, one of which has been withdrawn for reconsideration.

The establishment of the Commercial Standards Unit has brought to the fore several rather delicate issues. Chief among these is the question of the duplication of the type of work done by the American Standards Association. The procedure is similar; the stated objects are similar; the work is done in the technical field as well as the commercial; and the standards promulgated were, originally at least, presumed to possess a national status analogous to standards promulgated through the procedure of the American Standards Association.[4] Negotiations looking toward the establishment of a working agreement between the two organizations, eliminating such overlapping of functions, have long been under way.

The Certification Plan

The Certification Plan was inaugurated before the establishment of the Commercial Standards Unit. The general

[1] For the complete procedure see Appendix F of this volume.

[2] "Standards Yearbook, 1928," *op. cit.*, p. 126.

[3] National Bureau of Standards, Commercial Standards Unit, "Report of the Meeting of Planning Committee," Washington, Jan. 27, 1928.

[4] For a further discussion of this issue, see text, p. 259.

purpose of the Plan was to popularize the use of certain selected national specifications, "well recognized throughout industry" . . . but, "not widely used at the present time because of the inability on the part of most purchasers to determine whether or not commodities delivered correspond to the specification requirements."[1] It is expected by the promotors of the Certification Plan that the "willing-to-certify" lists will be used by both intermediate and ultimate consumers. These selected specifications are "government master specifications," upon the basis of which governmental supplies are purchased. At the time of publication of the 1928 yearbook, one hundred and fifty-one such master specifications had been applied to the certification plan, and seventy-five had been placed in form for distribution upon request.

> "Represented on these 75 lists are 684 separate individual manufacturing firms; the manufacturers average 2.35 specified commodities each. The average number of 'willing to certify' manufacturers on each list is about 21, the aggregate number of names on the 75 lists being 1,609."[2]

It was hoped, when the Certification Plan was initiated, that manufacturers signing the "willing-to-certify" statement would use their stated compliance with the master specifications as a basis for advertising and for guaranteeing to consumers—large and small, intermediate and ultimate—the quality of the manufactured goods. Architects, retailers, wholesalers, small business men and ultimate consumers do not, as a rule, possess the finances nor the equipment to test delivered goods in the manner employed by large concerns such as Montgomery Ward and Company, the General Electric Company, Westinghouse Electric Company, General Motors, etc.

While to date the "willing-to-certify" lists have not been used by ultimate consumers, architects or small business men to any considerable extent, and have not been employed very extensively in advertising, the number of manufacturers

[1] "Standards Yearbook, 1928," *op. cit.*, p. 148.

[2] *Idem.* See Appendix H for a list of the federal specifications used in the Bureau of Standards Certification Plan.

signing and the increasing demand for the lists promise to increase their usefulness in many fields.

Numerous organizations have certification plans, some of which have been very widely used. The national standardizing bodies in Great Britain, Canada, Czechoslovakia and Germany[1] have trade-marked symbols, which certify the quality of the product, as manufactured in accordance with the appropriate master specifications. The American Gas Association, the National Board of Fire Underwriters and other associations and societies have similar plans. In some cases the right to use the trade-mark is withdrawn upon demonstration of failure on the part of manufacturers to comply with specifications. The Bureau of Standards does not propose at any time to withdraw the name of manufacturers from the list, nor to determine whether compliance with the specifications is being practiced. This fact may well detract from the workability of the plan.

The American Marine Standards Committee

The American Marine Standards Committee was organized in 1922, and represents "a development of co-operation between the United States Department of Commerce, the United States Shipping Board and the American Marine Association."[2] The Committee is now comprised of about 330 member bodies, including shipbuilding firms, ship operators, naval architects, marine engineers, manufacturers, and other, educational, commercial and Government interests related to the marine industry.[3]

"An executive board, elected annually from and by the membership, appoints and controls the administrative officers and technical committees, directs the general policies, and defines the technical working program. In actual operation the Committee is regarded as a unit of the Division of Simplified Practice."[4] In the organization of its work it co-

[1] F. J. Schlink, "Memorandum on Certification of Commodities," unpublished, Nov. 28, 1925, p. 5. Files of American Standards Association.

[2] U. S. Dept. of Commerce, "Simplified Practice in the Marine Field," Washington, 1924, p. 1.

[3] "Standards Yearbook, 1928," *op. cit.*, p. 249.

[4] National Bureau of Standards, *Technical News Bulletin*, Jan. 1, 1928, pp. 9–10.

operates actively with the Bureau of Standards, the American Standards Association and several of the larger engineering societies. It is represented on several of the sectional committees of the American Standards Association. The Committee is located in the Department of Commerce Building and makes use of its facilities.

By the end of 1927, the American Marine Standards Committee had promulgated fifty-three standards, fifty-one of which it had published. The field of the Committee's activities is mainly confined to three divisions—hull details, engineering (machinery) details, and ship operation details. The work in these different divisions is carried on by technical committees, which in turn delegate parts of the work to subject committees to develop the details of the proposed standards. During 1927, in addition to its other work, the Committee organized in one of the large ship yards a plant standardization committee made up primarily of heads of the various departments.[1] It is expected that the work of this plant committee will become closely allied to that of the American Marine Standards Committee.

Central Committee on Lumber Standards

Somewhat similar to the American Marine Standards Committee in composition, but quite different in type of work, is the Central Committee on Lumber Standards, located in the Department of Commerce offices and made up of eleven representatives of lumber manufactures, wholesalers, retailers and consumers.[2] The object of the Committee is to serve, not in a judicial capacity, but "as a central clearing house between the industry and the Government in encouraging the putting into practice of those recommendations which have been indorsed by general conferences representing all branches of the trade and the public."[3]

The Committee drafts recommendations for approval by a general conference of all interested parties. Approval gives the recommendations the status of American Lumber Standards, to be published by the Division of Simplified Practice as such.

[1] "Standards Yearbook, 1928," *op. cit.*, p. 250. [2] *Ibid.*, p. 256. [3] *Idem.*

"The recommendations thus far published include lumber classifications, nomenclature of commercial softwoods, shipping practices, basic provisions for structural material, softwood factory and ship lumber, lumber inspection provisions, lumber abbreviations, American standard moldings, and standards for red cedar shingles. Simplification of sizes, nomenclature, grades, and trade practices has been accomplished in the softwood industry."[1]

"The central committee is now engaged on the following projects: uniform patterns for worked lumber, shipping weights and dryness of lumber, structural timbers, supply and demand survey of American standard lumber, and further attention to hardwood standardization."[2]

Foreign Governmental Standards Bodies[3]

The experience of foreign governments in the conducting of standardization work shows some rather interesting contrasts with American experience. In the first place, the national (non-governmental) central standardizing agencies do not differentiate between standardization and simplification as they do in the United States. Consequently, any simplification work is carried on as an integral part of the work of the national standardizing body. In the second place, the central governmental standards bodies, analogous to the Bureau of Standards in the United States, are concerned almost entirely with technical and scientific work of a more fundamental sort and leave to the central (non-governmental) standardizing committees or associations the task of applying the fundamental standards in industry, and of devising ways and means for securing the adoption of such standards by industrial executives.

A single exception to the generalization that in foreign countries simplification is carried on by the national standard body, is the Australian Commonwealth Association of Simplified Practice, organized in 1927 along lines similar to the Australian Commonwealth Engineering Standards Association. The new association is not, however, to be conducted as an entirely independent body. It will cooperate closely with, and in general follow the processes of, the Standards Association. "The Chairman of the Main Committee

[1] *Ibid.*, p. 257. [2] *Idem.*

[3] Not including Russia and Poland, where the national standards organizations are governmental bodies.

of each association is to be ex officio a member of the other association, and a joint correlating committee of the two bodies will provide against overlap of functions."[1] It was expected that the organization would be supported during the first year of its activity by the grant of money from the Commonwealth. This organization is, consequently, so closely allied to the Australian Commonwealth Engineering Standards Association, which in turn works in complete harmony with the Commonwealth Government, that its separate existence must be considered a device for facilitating standardization in a particular field, and to give an appeal to commercial rather than technical people, rather than as an attempt to set up a distinct and rival body such as the Division of Simplified Practice in the United States. The recent attempt to set up a separate division of Simplified Practice in Great Britain to form a part of the Board of Trade met with the conclusion that such work could be better and more appropriately handled by the British Engineering Standards Association.

In no foreign country has a body similar to the Commercial Standards group been set up. Consequently, even in countries where the standardization movement is not carried on in such broad lines as in the United States, standardization work is more highly centralized. It is difficult, on any rational basis, to justify the practice of setting up overlapping and rival organizations after a central national standards body has been established as a smoothly working, broadly representative and effective unit. It will require a great deal of effort in the future to prevent standards set up by the American Standards Association (American Standards), the Commercial Standards Group (Commercial Standards), the Division of Simplified Practice (Simplified Practice Recommendations), the American Marine Standards Committee (American Marine Standards), and the Central Committee on Lumber Standards (American Lumber Standards),

[1] *Sustaining Members Bulletin, op. cit.*, Feb. 14, 1928. The summary continues: "The Main Committee of the new organization will include two representatives of the Commonwealth government, six of the several state governments, two of the Engineering Standards Association, one representing the six State Advisory Committees of the association, one the associated Chambers of Commerce of the Commonwealth, one the Associated Chambers Manufacturers of Australia, and coöpted members."

from overlapping, duplicating, and contradicting each other, and thus reintroducing into industrial practice a measure of the confusion national standards are designed to eliminate.[1]

Foreign government standards laboratories have, however, cooperated quite as effectively—though in many cases on a more limited basis—with the national standardizing organizations as has the National Bureau of Standards. Of these national laboratories, the most important are The National Physical Laboratory of Great Britain, the German Physikalisch-Technische Reichsanstalt (National Physicotechnical Institute) and the French Laboratoire D'Essais Mecaniques, Physiques, Chimiques, et de Machines.

Although none of these bodies is as large as the National Bureau of Standards, the technical and scientific work covers the samė general fields. The Reichsanstalt conducts more actual tests of materials and instruments than any other similar agency. It has carried out perhaps the most complete set of tests for clinical thermometers ever undertaken. No such comprehensive tests for common building and structural materials as those conducted by the National Bureau of Standards have been undertaken by these foreign bodies. The National Physical Laboratory is equipped with a special tank, The William Froudee National Tank, ". . . for experiments on models of ships, to be at the service of the nation for research directed to the improvement of ship design and propulsion, and in which tests could be made at a minimum charge for the information of shipbuilders and shipowners."[2]

No foreign governments have attempted to set up certification schemes separate from those established by the national standardizing body. While the National Physical

[1] A prominent manufacturing executive, referring to the Commercial Standards Unit, writes, ". . . those who criticize the 'System' are not attacking or antagonizing the Government. . . . Briefly, this 'system' (an excuse for creating the Commercial Standard Unit of the Division of Simplified Practice of the Bureau of Standards of the Department of Commerce) is nothing more than a competitor of the Procedure of the American Standards Association (formerly known as the American Engineering Standards Committee)—except, however

(a) that it proposes to apply certain very questionable short-cut methods; and

(b) that it opens the way for the smaller or disgruntled concerns in an industry to create costly disturbance."

[2] The National Physical Laboratory, "The National Physical Laboratory, A Short Account of its Work and Organization," Teddington, England, p. 14.

Laboratory permits the use of its stamp, NB, on instruments such as clinical thermometers passing the Laboratory's tests, the practice is in no way comparable to the Certification Plan.

The German government has established one organization, the Reichskuratorium für Wirtschaftlichkeit, which has a rather unique relationship to the national standardization movement in Germany. As the name implies (National Institution of Economic Management) the Reichskuratorium is not engaged directly in standardization work. It exists as a central agency for the collection and publication of information relating to any phase of the broad rationalization movement, and for the disbursement of funds given it by the German government for the subvention of projects relating to any aspect of rationalization. Standardization is, of course, included in this movement.

The organization of the Reichskuratorium and the nature of its tasks are comparatively simple, despite the broad nature of rationalization. A project can originate from any reliable source. To secure recognition and aid from the Reichskuratorium, it is necessary only to establish the value of the project, the necessity for funds to carry on the appropriate research or other work involved in the carrying through of the project, and the fact that funds are not forthcoming from any other source. Funds disbursed to the Deutscher Normenausschuss for the year 1927–1928 amounted to a total of 22,128,947 marks.[1] The Reichskuratorium publishes a yearbook, a weekly bulletin, and numerous occasional publications dealing with various aspects of the rationalization movement.

[1] Reichskuratorium für Wirtschaftlichkeit, "RKW-Veröffentlichungen, Jahresbericht," Berlin, 1927.

CHAPTER VIII

STANDARDS IN GOVERNMENT PURCHASING

JUST when the various departments of the Federal Government began to work out standards and specifications for use in purchasing supplies is not a matter of record. Standards had been evolved, as elsewhere, long before their separate existence was realized. The very nature of a specification—which is, broadly speaking, nothing more nor less than a descriptive statement of the properties of the required commodity—makes it impossible to determine just when buying by specifications began. Certainly, few articles were ever purchased by the Government without at least more concrete descriptive material than that used by the ordinary commercial buyer.

But the practice of purchasing on specifications deliberately and carefully devised by technical experts, stating the minimum essential characteristics the materials or equipment purchasable under the specification must have, is a more recent development. It probably began with the Army and the Navy departments. The growth of military science, requiring the use of an elaborate and necessarily closely coordinated set of devices, machines and general equipment, called for increasingly exact requirements in the procurement of supplies. The United States Navy Department was not only one of the earliest of the federal departments to standardize its purchases, but it has also one of the most complete, thorough and best articulated sets of supply standards and specifications of any organized body, either governmental or private.

The first official recognition of the necessity and value of buying according to standards and specifications came with the establishment of the General Supply Committee by Congress in 1910. No further action along this line was taken until after the War, which showed conclusively the great advantages to be derived from centralized and co-

ordinated purchase of standard materials bought under definite and rigid specifications. Agitation within and without governmental circles immediately following the War, for greater economy in the conduct of the Government, led to measures designed to secure these ends. Legislation enacted in 1921 established the Bureau of the Budget, "to assemble, correlate, revise, reduce, or increase the estimates of the several departments and establishments."[1] Under this act, policy-forming powers were placed in the hands of a Federal Purchasing Board, while the actual drawing up and coordination of specifications was placed in the hands of a Federal Specifications Board, whose duties are, "to compile or adopt and promulgate, standard specifications for materials and services and to bring the Government specifications into harmony with the best commercial practice wherever conditions permit, bearing in mind the desirability of broadening the field of supply."[2]

Several states and municipalities have, in the course of the past few years, gradually evolved purchase specifications for a considerable portion of their supplies. Some of these specifications have been separately drawn up to meet peculiar local needs, but a great many of them have been adopted, in whole or with modifications, from engineering societies, the Federal Government and other bodies.

The Federal Specifications Board

The membership of the Federal Specifications Board is made up of representatives designated by "Each department and establishment purchasing materials and supplies in accordance with specifications."[3] An executive committee, comprising about half the membership of the Board, considers the problem of the need of a specification for a particular article or material. The project is then referred to a technical committee of government experts familiar with the particular subject, which selects or drafts a specification "suitable for the uses of all departments and establishments of the Government."[4] The advice and cooperation of com-

[1] "Standards Yearbook, 1927," *op. cit.*, p. 104. [2] *Ibid.*, p. 110.
[3] *Ibid.*, p. 111. [4] *Idem.*

mercial and industrial firms interested in the particular subjects are solicited by this technical committee. The report of the technical committee is sent to the various interested government departments and divisions and to the American Standards Association for securing criticisms and suggestions from industry. The final report of the technical committee, if approved by the Board, is promulgated as an official government standard. The use of the specification is mandatory upon all government divisions, bureaus and departments purchasing that particular supply item.[1]

The Federal Specifications Board had promulgated some 550 specifications by March, 1928. These "master"[2] specifications are divided into eight sections: General Specifications; Types, Grades, Classes, etc.; Material and Workmanship, etc.; General Requirements; Detail Requirements; Method of Inspection, Tests, etc.; Packing and Marking; Notes. A considerable number of these specifications have been given by reference in the General Supply Schedule, and they form the basis for the Bureau of Standards Certification Plan. Recently there has been an attempt to have Federal Specifications established as American Standards under the procedure of the American Standards Association. Three projects have already been so submitted. The fact that these specifications cover the same field, in many cases, as American Standards, and that the Certification Plan proposes to introduce Government Specifications into purchasing by industry, makes this step a very important one.

Standards in the Navy Department

The Navy Department has written specifications for practically all of the widely used materials required by the Department. For the same materials, the Navy Specifications

[1] With the exception of certain specifications that "are mandatory on the War Department, Navy Department, and Marine Corps only, and optional with other departments and establishments of the Government." See, "Circular of the Bureau of Standards," No. 319, p. 11. Exception is also made of strictly military and naval supplies, which the work of the Federal Specifications Board does not touch, and which are covered by specifications issued by those departments.

[2] Called "master" specifications because they establish the essential and controlling requirements for all government purchase of materials covered by these specifications. Adaptations to the needs of a particular department must not alter these essentials.

must be in accord with the master specifications, but a considerable quantity of the materials bought by the Navy are either of a peculiarly military nature or have never been brought up for consideration before the Federal Specifications Board.

Specifications are drawn according to a general procedure similar to that in use by the Federal Specifications Board, except that the work of inspecting, drawing the specification, etc., is apt to be in the hands of a single engineer or of a small group of engineers drawn from a particular division. To some extent, manufacturers are given an opportunity to participate in the process of formulation.[1]

Once a specification is established, all purchasing in all the branches of the Navy in different parts of the United States is required to be carried on by the given specification. Elaborate conditions for bidding and delivery require the submission of samples for testing at the plant of the manufacturer, and equally careful check by testing and inspection of the delivered goods. The country is divided into twelve districts, in which duly qualified technicians are maintained ready to go to any manufacturing establishment to conduct tests or to arrange for the delivery of goods bought under specification.

One interesting and, in a sense unusual, feature of the naval specification work is the awarding of contracts, in a few cases, not on the basis of the cheapest bid, but of the greatest service or utility returned per dollar invested. This may mean the purchase of either a cheap material, or one that is very expensive according to the customary units.

While several of the bureaus in the Navy Department are engaged in the formulation of standards and specifications, perhaps the most important work has been done by the Bureaus of Aeronautics, Construction and Repairs, Engineering, Supplies and Accounts, and Yards and Docks. The Bureau of Aeronautics has developed, in cooperation with the Army, certain Army-Navy, AN, standards, which "serve as master drawings and specifications for the two

[1] The standardization work of the Navy Department includes such items as rubber, hemp, padlocks, rivets, paints, lumber, corrosion resisting steels, recording meters for radio apparatus, medical supplies, etc. See, "Standards Yearbook, 1928," *op. cit.*, pp. 84–88.

services in the same manner as the Federal specifications."[1] Fifty-three such AN standards had been issued up to July, 1926. The other bureaus mentioned maintain close relationships with the Federal Specifications Board, the National Bureau of Standards, the various engineering societies, the American Society for Testing Materials or the American Standards Association, or with all of these bodies.

Standards in the War Department

The War Department, like the Navy Department, is much interested in standardization. In time of war it must rely to a very large degree upon proper specifications, for the reason that a considerable part of the necessary purchasing will be in the hands of comparatively inexperienced people. It is important in such circumstances to know from what sources standard goods and equipment can be purchased. In the actual conduct of war, as was so forcefully demonstrated during the last two years of the World War, success may depend to a large and even a crucial degree upon interchangeability of parts of machines, ammunition and other types of equipment. Not only is variety confusing, but it is very expensive, either in war or in peace.

Wherever possible, the War Department uses standards drawn by the Federal Specifications Board. Where master specifications are lacking, it issues its own specifications. A department technical committee, representative of the various branches of the Department, considers the preparation and development of standards referred to it by the Chief of Staff. Each supply branch has its own technical committees, which keep in close touch with the War Department technical committee. The general method of drafting a standard, the different parts of the specifications, the requirements for testing and inspection, etc., are similar to those used by the Navy Department and the Federal Specifications Board. The War Department maintains close relationships with the Bureau of Standards, and has representatives on several committees of the American Standards Association, of which it is a member body.

[1] "Standards Yearbook, 1927," *op. cit.*, p. 81.

The General Supply Committee

The General Supply Committee, organized in 1910 as a part of the Treasury Department, prepares the General Schedule of Supplies for the use of government departments and independent bodies in their purchasing. It is an interdepartmental body, working under the supervision of the Secretary of the Treasury and charged with the duty of maintaining and publishing the General Supply Schedule, the transfer and sale of departmental surplus supplies and the keeping of records of government surplus supplies and equipment.

The General Schedule of Supplies is issued in book form, and is supplemented by pamphlets from time to time. The 1929 schedule contains some 631 pages, including: the names and addresses of all contractors for the requirements of executive departments in Washington for supplies for one year in advance; special instructions for filing bids and filling orders; regulations relating to the making and enforcement of contracts; rules for testing samples and final deliveries; the policy of rejections; and 588 pages of buying description, including specifications. The specifications are listed by item name and number. The price at which a given number of units of a material will be delivered is quoted, followed by another price for extra units of the same supply. The time of delivery and the name of the contractor to whom the bid has been given follow the price statement.

Special Congressional legislation has not, except in very few cases, authorized the purchase of definite quantities of required materials in advance of use. Consequently, the price quoted in the General Schedule is based upon a bid by a contractor, who must count on the possibility of prices fluctuating either up or down during the coming year. Furthermore, the contractor does not know whether the supply he will be called upon to furnish will be great or small, or whether orders will be distributed over the year or will be bunched at a particular time. The bid price is therefore apt to be high rather than low, and is, for example, often higher than a single department store will pay for the same quality of goods in the same quantity. The nature of the con-

tract makes obligatory the fulfillment of all orders for materials upon which the contractor has been awarded a bid. Since the orders may be bunched, the contractor may be forced to abandon all other business contracts until the government contract has been fulfilled. This extra hazard, which has upon occasion been instrumental in practically eliminating the contractor from the commercial field,[1] has tended very decidedly to limit the field of potential bidders.

Certain supply lists are issued, however, for definite quantities of certain classes of supplies, such as tires, gasoline, oil, meats, etc. Manufacturers tend, of course, to bid lower on these commodities than on those listed in the General Supply Schedule because of the more definite terms of the contract.

Wherever a Federal Specification Board standard exists, it is used in the supply schedules. Other specifications are worked out by representatives from the different executive departments, and are not binding upon any department. In some branches of the government, notably the Post Office Department, the General Supply Schedule has been little used because of the specialized nature of requisitions. As a rule, proprietary or trade-marked goods are not listed, except where there is no complete competition between different makes, or where one make can not be freely substituted for another, as in the case of mimeograph machines, typewriters, adding machines, etc.

States and Municipalities

The Federal Government, through the Bureau of Standards, the Department of Agriculture and certain of the bureaus of other executive departments, has given advice and counsel to a considerable number of states and municipalities interested in buying on specifications. Several of the states, notably New York, Wisconsin, Massachusetts and, to a lesser extent, New Jersey and California, have worked out a limited number of specifications, quite irregu-

[1] For example, a large truck manufacturer during the Pershing expedition into Mexico.

larly applied in most cases, for their own purchase requirements.

State standards and specifications seem to have been most widely used by the State Highway Commissions.[1] In many cases, standards have been used in the purchase of supplies for state institutions, printing supplies, school supplies and supplies for the various state departments. Frequently, purchase on specifications is followed by testing in state laboratories. Specifications may be drawn by state-employed technical experts, or may be based partially or entirely upon specifications of the American Society for Testing Materials, the Bureau of Standards, or the American Standards Association.

With few exceptions, wherever the city manager or commission forms of city government have been instituted, some sort of purchase specifications have been worked out.[2] City purchases are in some cases centralized, and in others, departmentalized. A few cities, such as Baltimore, Portland (Ore.) and St. Louis, have established municipal bureaus or boards of standardization. Others, such as Rochester (N. Y.), Grand Rapids, Detroit and Los Angeles, maintain testing laboratories. The city purchasing agent, or chief buyer, is authorized in some cities to purchase on a specification basis. New York City has set up a limited number of purchase specifications.

The standards and specifications used by the municipalities may be their own, those of the American Society for Testing Materials, the Bureau of Standards, or others. The opinion prevails in some quarters that the total utility of specifications used by municipalities is, except with respect to highway materials, quite insignificant. From the evidence at hand, it would appear that the percentage of the total purchases of these cities made on the basis of the specifications is quite small. The unsatisfactory condition of the purchase requirements of New York City, supposedly one of the leaders in the field of purchase specifications, seems to

[1] "In every one of the forty-eight states standards for materials used in the construction and maintenance of roads and bridges have been established by the state highway commissioners." "Standards Yearbook, 1928," *op. cit.*, p. 229.

[2] *Ibid.*, p. 225.

warrant considerable skepticism as to their use by American cities in general.[1]

Considerable effort has been expended by the Bureau of Standards in its attempt to persuade state and municipal authorities to adopt purchase specifications. The increasing number of inquiries coming from such sources to the Bureau of Standards seems to show growing interest in the subject. The Bureau of Standards refuses, however, to permit either state or municipal authorities to give their citizens the direct benefit of government specifications for use as ultimate consumer purchase requirements, and accordingly will not permit the publishing of its findings with respect to compliance of particular makes with its specifications.

[1] The following national associations of state officials have been interested, in varying degrees, in standardization:

International Association of Industrial Accident Boards and Commissions; Association of Government Labor Officials; American Association of State Highway Officials; National Association of Railway and Utility Commissions; and the National Association of State Purchasing Agents (now a part of the National Association of Purchasing Agents).

CHAPTER IX

INTERNATIONAL AND REGIONAL STANDARDIZATION

THE conditions giving rise to the establishment of international standards are, in many respects, similar to those necessitating the promulgation of national standards. The growth and increasing complexity of industrial processes, mass production and mass selling have brought about a degree of international economic interdependence only less significant than the interdependence that obtains within the confines of each individual industrial nation. The needs of importers and exporters for a clear understanding of materials bought and sold, of standards for comparison and contrast, in order to be able to buy competitively are no less basic in international trade than in domestic trade.

In a sense, standards are more necessary in international trade than in domestic. Differences in language, legal systems and terminology, the (generally speaking) wider geographic removal of buyer and seller, the difficulties of suit and legal reprisal and other obstacles require an extremely smooth-working system of conditions and properties of materials or equipment, methods of procurement, transportation and delivery.

At any rate, contemporaneous in recent years with the increase in the volume of international trade and the growth of national standards movements, has come a growing interest in international standards. While the movement for the establishment of international standards is still in its infancy—at least as regards standards of direct and immediate industrial significance—a considerable body of such standards has already been worked out. Only those standards that have been accepted by all or most of the industrial countries are officially recognized as "International Standards." Standards that are the products of cooperative

effort of a few nations are sometimes referred to as "regional standards," since they are generally worked out on a regional or geographic basis.

There is, of course, no very clear line drawn between these two types of standards.[1] "International" standards may be broadly defined as those which represent the cooperative effort of most of the principal producing or consuming nations, having a major interest in the standard. Regional standards, worked out through the cooperative effort of a minority of the national standards bodies or other national representatives, may be elevated to the status of international standards upon the acceptance of these standards by all the major interested nations.

International Standards Organizations

The various international standards organizations have tended to specialize on one or another of the three important phases of the standardization process. They have concerned themselves almost entirely with the standardization of fundamental and basic scientific standards of length, measurement, physical constants, etc.; have specialized in narrowing the "angle of divergence" between existing standards in industrial use; or have interested themselves in the promotion of standards worked out by any duly authorized body.

The International Bureau of Weights and Measures, the International Union of Pure and Applied Chemistry, and the International Geodetic and Geo-physical Union are examples of the first type; the International Electrotechnical Commission, the International Congress for Testing Materials, the International Conferences of the Secretaries of the National Standards Bodies, the proposed International Standards Association, and the Phoebus Laboratory represent the second type; and the International Chamber of Commerce, the International Management Institute, the Pan-American Standardization Conference, and the International Labor Office, the third type. Some of these organi-

[1] Some readers may be interested in the rather ingenious scheme for solving this problem worked out by the Swedish Machine Industries Association and presented in the Appendix to the Minutes of the Second Unofficial Conference of the Secretaries of the National Standardizing Bodies at Baden and Zurich, July, 1923.

zations, particularly the International Union of Pure and Applied Chemistry, the International Electrotechnical Commission and the International Commission on Illumination, do standardization work both of the first and the second type described.

International standards organizations may also be grouped according to whether they are made up entirely of government representatives, are entirely non-governmental, or are representative of both government and industry. The International Bureau of Weights and Measures and the Pan-American Standardization Conferences are examples of the first; the International Chamber of Commerce and the International Management Institute, of the second; and the International Electrotechnical Commission, the International Commission on Illumination and the International Standards Association of the third group.

The International Bureau of Weights and Measures

The Metric Convention of 1875, "signed at Paris by the plenipotentiaries of most of the leading occidental nations,"[1] established the International Committee on Weights and Measures, the International Bureau of Weights and Measures and the International Conference on Weights and Measures.[2] The International Conference, now made up of duly accredited representatives of thirty-one national governments, meets every six years to decide questions relating to the adoption of international standards, and delegates to the International Committee the task of supervising the International Bureau of Weights and Measures. The recommendations of the Bureau are passed upon by the International Conference. Adoption of any proposition by the conference can be secured only by the unanimous vote of all nations represented, each nation having one vote.[3]

"The recommendations of the conference are, in effect and when ratified, binding on the signatory powers, and because of this fact and because unanimous agreement is required for adoption, the process of effecting important changes is

[1] "Standards Yearbook, 1927," *op. cit.*, p. 7.

[2] "Standards Yearbook, 1928," *op. cit.*, p. 5.

[3] *Idem.*

usually slow."[1] Despite that fact, important standards have been established, the nature of which can only be briefly indicated here.

Considerable work has been done in the field of standard physical constants and the establishment of standard conversion coefficients for checking national prototypes. Much of the work accomplished in this field has necessitated a further standardization of scientific nomenclature, signs and symbols. This work has had considerable significance from the point of view of the strict comparability of scientific experimentation carried on in different parts of the world. The numerous *controls* and conditions under which scientific experiments should be carried out in order for the results to have scientific or industrial significance necessitate the establishment of standard nomenclature, standard temperatures and temperature scales, and standard definitions.

The work of the Bureau is carried on, as the Committee may decide, in one of the national laboratories. Most of it has been carried on in the Bureau of Standards, the National Physical Laboratory or the Physikalisch-Technische Reichsanstalt, because of their size and equipment.

The International Electrotechnical Commission

This Commission was organized in 1906 as an outgrowth of a resolution adopted by the St. Louis Electrical Congress in 1904, stating the desirability of taking steps "to secure the cooperation of the technical societies of the world by the appointment of a representative commission to consider the question of standardization of nomenclature and rating of electrical apparatus and machinery."[2]

The Commission is a central body, representative of the National Committees. These National Committees, now closely affiliated for the most part with the national standardizing bodies, "are free to establish their own rules, any self-governing country having the right to form a National Committee,"[3] and have, in the Commission, equal votes and

[1] *Idem.* [2] *Ibid.*, p. 16.

[3] Guido Semenza, "Third International Conference on Standardization of the Chairmen and Secretaries of the National Standardizing Bodies at New York," April 15–22, 1926, New York, 1926, Appendix II.

financial responsibilities are divided according to the size of the electrical industry in each country. The Council of the Commission, which is the central executive body, delegates the carrying out of the work of the Council to a Committee of Action. The latter, in reality a sub-committee of the Council, is enabled, on account of its small size, to meet at quite frequent intervals. The National Committees may send in recommendations and suggestions for consideration at these meetings. The standardization work of the Commission is done mainly by international Advisory Committees, "which have been appointed to study subjects of general importance to the development of the electrical industry of the world."[1] The electrical standards established by national standardizing bodies form the groundwork and furnish the necessary details upon the basis of which international electrical standards may be devised.

The standardization work of the Commission has been done mostly in the fields of electrical nomenclature and the ratings of electrical machinery, "in which the endeavor is being made to establish an international basis for the comparison of electrical tenders by recommending test conditions which can be applied universally."[2] The technical features of this problem are not nearly so difficult as is the task of securing the cooperation of manufacturers of electrical machinery in different parts of the world. Recently, the Commission has expanded its standardization activities to include "prime movers," particularly hydraulic and steam turbines, and the establishment of performance and testing method standards for new materials, such as aluminum, insulating oils, etc. An Advisory Committee was appointed in 1927 to undertake the task of working out a uniform and standard system for the rating of rivers.[3]

The International Commission on Illumination

The International Commission on Illumination was organized in 1913 to succeed the International Photometric

[1] *Idem.* [2] *Idem.*

[3] In general, the Commission has been engaged in "narrowing the angle of divergence" between national standards, practices and ratings of machinery rather than with formal promulgation of standards.

Commission, formed in 1900, and to carry on studies of "all systems of lighting and technical problems connected therewith."[1] This involved "bringing together for work of common interest the representatives of industries of which not merely the modes of production or manufacture are totally different, but which are in competition commercially."[2]

National technical illuminating societies, representative of engineering societies and trade associations interested in illuminating problems in the gas or electric industry, form autonomous National Committees, which nominate the delegates to the International Commission. Executive power is in the hands of the Executive Committee, whose duties are to maintain the Central Bureau, provide for the calling of plenary meetings of the Commission, draft the agenda for these meetings and provide for the establishment of special standing committees charged with the task of considering specific standards proposals. Standards are established by a four-fifths vote of the official delegates at the plenary session.

Because of a period of inactivity during the War and the difficulty of reviving interest in the work of the Commission during the period of post-war readjustment, the accomplishments of the International Commission on Illumination are not great. Many technical papers have been read at its various meetings, and some steps have been taken to secure definitions of luminous intensity and fundamental quantities used in illumination and photometry, and to secure "uniformities in lighting practice for the factory, the school, and for automobiles."[3] Some effort has been directed to the task of securing uniform illumination legislation. The technical work is carried out, for the most part, in the national laboratories, where such exist.

The International Conferences of Secretaries, and the International Standards Association

General direct cooperation between the national standardizing bodies began with the first general conference of

[1] "Origin, Development and Work of the International Commission on Illumination," *Transactions of the Illuminating Engineering Society*, New York, July, 1928, p. 605.

[2] *Idem.*

[3] "Yearbook, 1928," *op. cit.*, p. 25.

secretaries of the national standards organizations, held in London in 1921. This conference, and a second held in Zurich in 1923, were "unofficial," in the sense that the conferees were paid secretaries with no authority to take official action. A third conference, called at New York in 1926, and including chairmen, secretaries and other officials of the national standards organizations, began to carry matters beyond the discussion stage.

Prior to the 1926 meeting, a considerable body of information concerning the work of the various national standards bodies had been exchanged. The office of the Swiss Standards Association had for three years "acted as an informal secretariat to facilitate the interchange of information, and to further negotiations to bring about uniformity between the national standards in the different countries."[1] More definite action was taken at the New York meeting, at which international technical conferences were held on ball bearings, limit gaging, screw threads, bolt and nut proportions, and preferred numbers.[2]

This conference took up, for the first time, the matter of organizing an international standards association. A draft constitution was drawn up, and an international Committee of Seven was appointed to confer with the International Electrotechnical Commission before the constitution was submitted to the national bodies for final ratification.[3] The difficulty of reaching complete agreement with the International Electrotechnical Commission, the need for securing the official adherence of several of the national standardizing bodies and certain questions involving the scope, significance and authority of international standards that might be set up, delayed the establishment of the association.

A temporary office was established in London, however, to carry on the work of international standardization. At a meeting of the Committee of Seven, held in London in November, 1927, it was decided that the International Standards Association "be established immediately, provided the necessary funds be forthcoming for 1928, 1929 and 1930."[4] Meanwhile, the British representative has dropped out, the office of the International Standards Association has been

[1] *Idem.* [2] *Idem.* [3] *Idem.* [4] *Idem.*

moved to Zurich. The Association has already received the approval of fourteen countries.[1]

In this connection it is interesting to mention the proposal to form a Comite d'Entente as a central committee to correlate, integrate and unify the work of the various international standards organizations, where the respective fields of activity are of moment to more than one organization.[2]

Just what will be the future of the International Standards Association, if it is finally organized, or of such an organization as the Comite d'Entente, is difficult to forecast. The issues involved in the establishment of international standards are very complex, and many of them are very controversial. In any event, such standardization is bound to be developed very slowly. But the growth of international standards organizations, and the increase in the activity of the national standards bodies, will tend soon to create a real need for the establishment of some central clearing agency.

Agencies Promoting International Standardization

The technical and scientific standardization work done by the various international standards agencies has been reported in the technical journals, and much publicity has resulted from the use of their standards as a basis for national legislation. In addition, several of these international bodies have confined their activities to spreading the ideas underlying standardization and popularizing the use of drafted standards—local, national and international.

Examples of this type of standards activity are to be

[1] The approving countries are: Austria, Belgium, Czechoslovakia, Denmark, Finland, France, Germany, Holland (with reservations), Hungary, Italy, Norway, Russia, Sweden and Switzerland. See, *Sustaining Members Bulletin*, *op. cit.*, Nov. 7, 1928.

[2] The following international organizations are to take part: International Illumination Commission, World Power Conference, International Conference on High Tension Lines, International Consultative Committee on Long Distance Telephone, International Union of Tramways, Local Railways and Public Motor Transport, International Union of Producers and Distributors of Electrical Energy, International Electrotechnical Commission. See circular letter to national standardizing bodies from Sir Richard Glazebrook, Chairman of the Committee of Seven for the London Meeting, Dec. 13, 1927; also the address delivered by Guido Semenza, President of the International Electrotechnical Commission at its Bellagio Meeting, Sept., 1927, "Rapport General des Reunions Tenues a Bellagio," London, 1927, pp. 45–46.

found in the work of the International Chamber of Commerce and the International Management Institute. The former body will "not go into the field of technical standardization but will use its prestige and facilities to further the standardization movement and to promote the use of recognized standards and the actual understanding of such work on the part of nations engaged in international trade."[1] The Institute, organized in 1927, is concerned with the promotion of the several aspects of economic rationalization, of which standardization is an important one. It issues a monthly bulletin in which it summarizes, for the benefit of its subscribers, important and interesting standardization projects and accomplishments in various parts of the world.

Regional Standardization

A great deal of standardization work is carried on through the cooperation of two or more of the national standardizing bodies. The Dutch, Swiss, Swedish, Czechoslovakian, Austrian and German standards associations have cooperated very closely on many different projects. In many cases, even where the national standards bodies have not cooperated in the formulation of standards, the drafted standard has been adopted by other national bodies. In many mechanical and electrical products, for example, Czechoslovakia follows German practice. Russia, Japan and Austria maintain engineers abroad for the specific purposes of translating standards and specifications of interest and value in their own industrial practice.

Trade associations and engineering societies of different nations have cooperated frequently to achieve common standards. While such activity is not as common as it was before the growth of the great national standards bodies, it still exists. Frequently, such action forms the preliminary step in the development of international trade agreements or cartels. A German mining journal,[2] for example, recently

[1] P. G. Agnew, "International Standardization," First Pan-American Conference on Uniformity and Specifications, Lima, Peru, Jan., 1925, Washington, 1925 (unpublished). See also, The International Chamber of Commerce, "Standardization," Brochure No. 10, Paris, 1921.

[2] *Bergwerkszeitung*, Essen, Nov. 16, 1927.

reported the calling of a joint conference between representatives of the British Aluminum Hollow-Ware Manufacturers Association and the German Federation of the Aluminum Ware Industry, for the purpose of standardizing aluminum ware. Cooperation with other countries was expected, in the future, to establish world standards for aluminum ware.

The great interest of the British Empire in the development of trade, and in Imperial commercial and industrial solidarity, has led to frequent discussion concerning the feasibility of establishing Imperial Standards. Although, in actual practice, many of the standards adopted by Dominion organizations are those of the British Engineering Standards Association, the movement for Imperial Standards seems to have gone little further than the agitation stage.

Regional standardization on the American continents has made some headway. Two Pan-American Standardization Conferences have been held.[1] The first Conference merely established a basis of interest for future discussion. The second Conference paid particular attention to the problem of the standardization of agricultural products in which the Latin American countries are especially interested.

More progress has been made in cooperative standardization work between the United States and Canada. The Canadian Engineering Standards Association has been represented, in some capacity or other, in several of the projects of the American Standards Association. Geographic proximity, and the fact that the economic interests of Canada and the United States coincide more directly than those of either country with any other nation, forecasts increased liaison work of these two bodies in the future.

[1] Lima, Peru, Jan., 1926 and Washington, D. C., May, 1927.

CHAPTER X

AGRICULTURAL STANDARDIZATION

NO descriptive survey of industrial standardization would be complete without at least some mention of the very important standards work being accomplished in agricultural fields. Up to very recent times, probably no line of products has so completely escaped formal efforts at standardization, and at the same time has become so highly standardized, as agricultural produce.

Phylogeny and ontogeny record the development of genus, species, family, and their innumerable variations of size, shape, coloration, taste, chemical properties, smell, etc., by natural selection and adaptation to environment, into the most infinitely complex, yet standardized, forms of plant and animal life. This long process of differentiation and standardization of type has gone on without, for the most part, any interference on the part of man and without the conscious application of known scientific principles. The domestication and artificial cultivation and breeding of plants and animals by human beings form but a very small part of the total process. For the most part, the efforts of human beings have been directed to the use of selected plants and animals, rather than to the modifying of forms of life to increase their usefulness to human beings. Between these two activities there is, of course, no sharp dividing line.

Occasional references in ancient literature and architectural and archeological remains show a limited use of equally limited information about ways and means of adapting plant and animal structure for human use. The Egyptian Hyksos were supposed to have developed fine strains of horses through selective breeding, and the writings of Pliny and Columella contain many hints to the Romans of their times on methods of bettering their stock and produce. But the deliberate application of scientific principles to selective breeding of certain plant and animal stocks, and the devel-

opment of "best" methods of care during the period of growth, in order to attain certain definite and standard types of products, is a recent development.

Difficulties in Agricultural Standardization

The gradual discovery that seemingly invariable types could be changed to meet certain desired standards, and that, accordingly, standards could be established for agricultural goods, also revealed several difficulties to be overcome in this process, more or less peculiar to agricultural standardization. The body of information cumulatively developed through the growth of the biological and botanical sciences did much to remove one of the greatest difficulties—that of devising standard agricultural nomenclature. But two difficulties remain even here. In the first place, scientific terms and classifications are not those ordinarily used by growers, in the market, or in common agricultural discussion. The difficulty of standardizing agricultural nomenclature lies largely in overcoming colloquialisms and patois, sometimes of a very confusing nature. Further, there is considerable trouble to be met in the attempt to measure the properties of agricultural products—especially foods—by definite standards permitting the use of instruments instead of personal judgment. Just what is a good apple, or a good beefsteak? Are the essential qualities the same for all people, and can those qualities be tested with any degree of accuracy?

Another major difficulty in agricultural standardization is the setting up of a single standard to cover several desired properties in the same product. For example, "the factors of importance in determining the value of wool for certain purposes are four: diameter of fiber, length of fiber, spinning quality of fiber, and amount and character of shrinkage."[1] The standards now in use by the Federal Government are based wholly on diameter of fiber. Fortunately, there is a fairly consistent relationship between this variable and the others. Where individual variation in taste plays a more important part, such a correlation is much more difficult to find.

[1] Lloyd S. Tenny, "Standardization of Farm Products," *Annals*, *op. cit.*, May, 1928, p. 210.

In growing agricultural products to meet standard requirements, there are many variable factors that are difficult, if not impossible in some cases, to standardize. Chief among these is the variation in weather conditions. The use of greenhouses, the changing of soil conditions and the adaptation of particular varieties to particular weather conditions are methods employed to overcome this difficulty. Likewise, chemical research, the development of types of plants capable of resisting certain diseases, and counter diseases are enabling standard disease controls to be worked out. In Australia, for example, pests have been imported from the United States which are particularly destructive of the great Australian agricultural pest, the prickly pear. The ravages of the boll weevil have been diminished by the development of standard chemicals and devices for spraying.

Considerable research has been necessary in nearly every phase of agricultural standardization work. Such research has uncovered definite and controllable elements in agricultural products, and has formed the basis for the elaboration of ways and means for controlling the final result. But research has uncovered a further difficulty—the fact that nearly every different agricultural product requires a treatment, a handling, and a care more or less unique. In other words, is has been very difficult to *standardize the standardization procedure* for agricultural products.

Influences Forcing Agricultural Standardization

Despite the difficulties inherent in the problems of agricultural standardization, the most untutored layman is familiar with scores of agricultural standards. Guatemalan bananas, Hawaiian pineapples, California citrus fruit, Hood River, Wenatchee and Yakima apples, Maine potatoes, Swift hams and bacon, Rogue River pears, etc., are standard with reference to size, weight, color, degree of ripeness, taste and smell. The most unskilled layman is able to discriminate between the different grades by common knowledge of the current market.

The development of standard methods of handling agricultural products in the processes of harvesting, packing,

transportation, storage and distribution has followed closely upon the development of modern railroad and steamship transportation facilities. The ability to carry meats, fruits and vegetables over long distances has coincided with and vastly accelerated farm specialization, on the one hand, and the development of great agriculturally-dependent urban centers, on the other. This process has brought geographically isolated agricultural regions into sharp competition with the more accessible regions and with each other. The discipline enforced by the necessity for careful and scientific standards of quality and conditions of transportation has tended to bring agricultural standardization to the highest degree of perfection in the outlying regions—that is, regions the farthest removed from the large markets.

For many commodities there is a world market. The prices of graded wool, cotton, wheat, tobacco, coffee, rubber, silk, hides, certain cuts of meats, etc., are based upon world supply and world demand. This very fact has demanded the establishment of standards in these products. Import and export tariffs, rules and regulations with reference to these commodities necessitate a clear understanding of just what is meant by Grade A tobacco, "raw uncombed silk," etc. The further fact that plant and animal diseases and pests are transported with agricultural products necessitates certain standards of freedom from disease and pests. Purchase at a long distance is immensely facilitated by the use of purchase specifications that call for standard grades, sizes, qualities, etc.

Other forces making for agricultural standards are the desire to maintain health standards by standardizing the condition of food for human consumption, and the desire to cheapen production of agricultural goods by enlarging markets, cheapening processes of growing, cultivation and handling, and eliminating pests and diseases. The purchase requirements of cities, states and the Federal Government, which in many instances purchase food on a large scale, have come more and more to be based upon certain generally accepted properties, and have thus encouraged the development of standards. The recent development of national grocery chain stores has added impetus to the movement.

Standardization Work of the Department of Agriculture

The most important single organization engaged in agricultural standardization work, in the United States or abroad, is the United States Department of Agriculture. This work has been largely centralized in the Bureau of Agricultural Economics, and in the Food, Drug and Insecticide Administration. Part of the experimental work involved in the establishment of standards is conducted in the buildings in Washington, D. C., and on a nearby experimental farm, but the most of it is carried on at the state agricultural schools and universities. Standards developed are issued as "mandatory," "permissive," or "tentative" for government use, or for government inspection of goods passing in interstate commerce under federal control.

The standardization work is carried on by seven separate divisions. Standards have been developed for practically every important commodity, including hay, grain, cotton, live animals, meats, wool, eggs, honey, fruits and vegetables. Standards are established for methods of testing, sampling and inspecting; for crates, cartons, boxes, barrels and other containers; for methods of picking, packing, transportation and storage; for fertilizers, insecticides and fungicides (to a limited extent); and for grades, names, types and classes, etc.

The passage of the Cotton Futures Act in 1914, the Grain Standards Act in 1916, and the United States Warehouse Act in 1916 definitely established the work of the department in these fields. "The use of the official cotton and grain standards of the United States is required in all transactions based on grade, and any standardized grades which may be formulated and issued under the warehouse act are also mandatory for the purpose of the act."[1]

These standards, many of which have been in the process of development for many years, as far as actual content is concerned,[2] have in some cases been internationally accepted. "The official cotton standards of the United States for American upland cotton were adopted by the leading cotton

[1] Lloyd S. Tenny, "National Standards for Farm Products," Circular No. 8, U. S. Department of Agriculture, Aug. 1, 1927.

[2] Cotton grading began at Liverpool about 1800; grain grading began about seventy-five years ago.

exchanges of Europe during the summer and fall of 1923, and an agreement was entered into between the United States Department of Agriculture and the European exchanges to facilitate the use of the standards in foreign commerce."[1] International standards for wool have been worked out, largely based upon the standardization work of the Department of Agriculture.

Agricultural Standardization by Producers' Cooperatives

Some of the most thorough and significant agricultural standardization has been accomplished by producers' cooperatives. "The cooperative organization handling 'Sunkist' oranges and lemons, for instance, has not only set up standard picking and handling practices, but has developed standard field boxes—one each for oranges and lemons. The standards for these shipping boxes have been established with regard to the number most advantageously packed in a refrigerator car as well as with relation to the number of oranges or lemons to be contained. Standards have been devised also for the size and kind of tissue paper used for wrapping the fruit and the quality of paper and number of colors for box labels."[2]

Similar standards have been worked out by California and Oregon walnut and prune producers, and by Hood River, Yakima and Wenatchee apple growers. In the walnut industry, for example, grading and other operations involved in the handling and sorting of the product have been almost entirely mechanized. This work has been facilitated by the passage of legislation in California authorizing the State Department of Agriculture to set up agricultural standards.

> "A further movement in the direction of state cooperation is the certification service established by act of January, 1927. This legislation provides that, upon payment of a fee, agents of the State Department of Agriculture may inspect and certify as to grade standards of any shipment of produce."[3]

These certifications may be used as the basis upon which to secure loans on warehouse receipts.

[1] "National Standards for Farm Products," *op. cit.*, p. 10.

[2] Paul E. Holden, "Agricultural Standardization on the Pacific Coast," *Annals*, *op. cit.*, May, 1928, p. 111.

[3] *Ibid.*, p. 113.

Agricultural Standardization in Foreign Countries

While nowhere carried out on the pretentious scale that obtains in the United States, agricultural standardization is carried on in many foreign countries. A Reichskuratorium für Technik in der Landwirtschaft (Federal Board of Trustees for Agricultural Technique) has been established in Germany to "promote the preparation and spread the general use of all manner of technical appliances, processes or other means conducive to economic production in agriculture, forestry, market gardening, fruit and vine growing."[1] Similar work has been undertaken by the governments of Bulgaria, Czechoslovakia and Russia. The problem of competing with foreign agricultural producers has brought up the question of standardization in England.[2] The Roumanian "Minister of Agriculture and State Lands has . . . presented a draft bill providing for the standardization of exported cereals according to known types which are accepted on the world market."[3] In the Australian State of Victoria, "the State Department of Agriculture protects its farmers by maintaining a strict supervision of all fertilizers sold to see that they conform to required standards."[4] The Australian Institute of Science and Industry, in cooperation with the Australian Commonwealth, the States, and producers, carries on quite extensive agricultural research, and has developed methods of coping with numerous pests and diseases.[5] In South America, coffee grades, types, methods of cure, etc., have been standardized by Brazil and some meat and grain standards have been worked out by Argentine.

The fact that in agriculture, as in industry, standardization is almost entirely a product of post-war times, and that the movement has gained such momentum in the brief period in which its value and usefulness have been recognized, presages important and significant developments for the future.

[1] *Bulletin of the International Management Institute, op. cit.*, Dec. 1927.

[2] *Ibid.*, Jan., 1928. Summary of a speech delivered by Mr. Street, of the British Ministry of Agriculture, at a meeting of the Westmoreland farmers, Oct., 1927.

[3] *Ibid.*, May, 1928.

[4] Department of Commerce, Press Memorandum, July 27, 1928.

[5] See, the Annual Reports of the Director of the Commonwealth of Australia Institute of Science and Industry; also, the *Journal of the Council for Scientific and Industrial Research.*

Part II

CHAPTER XI

BUSINESS SAVINGS FROM STANDARDIZATION

THIS chapter constitutes an investigation into the conditions under which industrial standardization, intelligently applied, can be made to increase business profits. It will be found that industrial standardization increases profits by cutting costs of buying, processing, distributing and selling, and by extending markets. Numerous estimates of savings realized through standardization support the contention that these savings are so great and so significant that no large industry can any longer afford to ignore the standardization technique. This statement is made in spite of the fact that the general character of the available estimates of savings through standardization is such as precludes a definitive statement of precise amounts saved. These estimates of savings realizable to the public or to broad industrial groups by the application of standards, either to limited or to general fields of industrial usage, have served to stimulate discussion, but are of little scientific value. Thus the estimate of the Division of Simplified Practice that $10,000,000,000, or one third of the $30,000,000,000 of annual industrial waste in the United States reported[1] by the Federal Engineering Societies in 1920, might be saved by the introduction of industrial simplification and standardization, while interesting and perhaps highly illuminating to the uninformed, is simply a plausible guess. Likewise, such an estimate as that made by the American Standards Association, that an annual saving of $1,000,000,000 would accrue to American industry through the universal application of standard limit gages,[2] is no doubt indicative of a very great industrial need and

[1] R. M. Hudson, letter to American Standards Association, Nov. 25, 1926, files American Standards Association.

[2] American Standards Association, News Release, Jan. 8, 1926.

probably served its publicity purposes very well, but it is equally certain that little attention was paid to the number of ciphers laid down.

Not much more fortunate are the numerous estimates of savings attributable in whole or in part to the introduction of standards in specified industries. The automobile industry may have saved $750,000,000 a year through standardization; the lumber industry, $250,000,000 a year; and the brick industry, $1,000,000 a year; the building industry may have lost $2,000,000,000 by lack of standardization, but there seems to be no conceivable way of checking up on the figures. While the method of arriving at the estimates would not stand close examination, it does not follow, of necessity, that the estimates are worthless. It merely means that they are useless from the point of view of an exact knowledge of actual money savings attributable to standardization. The very form in which these numerical estimates are expressed indicates that they do not purport to be exact. Besides numerous theoretical and practical objections to estimates as such, further difficulties arise in attempting their use in this study. Who benefits from the savings made? Who saves when the width and thickness of the board foot is standardized; when the sizes of bricks are simplified; when the automobile is manufactured under mass-production conditions and with interchangeable parts? Does the cutting of inventories, of costs of processing, etc., of necessity mean the lowering of price to consumers, the raising of wages to laborers, etc.?

Careful, accurate and comparable cost accounting systems would do much to clarify these general questions. They would also do much towards determining departmental responsibility within an individual business for gains and losses due to the introduction of standards. But this issue is different from the one above in that savings or losses are known, and the problem arises as to their allocation to the proper department or their crediting to the proper change, innovation or lack of innovation. In deciding who benefits from savings, it is not always known that a saving to one business is not a loss to another. Consequently, it is necessary to deal first with money savings within particular

industries and in particular business enterprises, and then to attempt to determine the incidence of these savings outside the particular business.

The fact, however, that even for particular industries the available information on money savings due to standardization is given out as estimates, and not as data based on cost accounts—although in many cases the estimates are probably based on some such data—forces additional caution in dealing with this material. Before any saving can be shown at all, certain variables, such as fluctuations in the price level, must be accounted for. Before savings can be attributed specifically to any one department or to any settled policy or procedure such as standardization, it must first be shown that several other variable factors[1]—for example, new sources of supply and new markets being opened by railroad extensions or canal improvements, or the abatement of war or political readjustments—are not partially or wholly responsible for the savings effected.

The number and character of variables suggest that perhaps the most satisfactory approach to the question of money savings due to standardization would be to study the savings of mass production, and then to attempt to determine the extent to which standardization has facilitated mass production. A high degree of standardization is implicit in modern industry. The more completely an industry is placed on a mass-production basis, the more standardization of "input," methods and "output" is required. Mass-production methods, requiring high degrees of standardization, are characteristically economical production methods. Consequently, the economies of mass production are largely the economies of standardized production. Logically, the one can not be completely separated from the other. But since this study relates to standardization and not to mass production *per se*, it is desirable to point out the extent to which standardization enables manufacturers and retailers to realize the economies of large-scale production. The following discussion, therefore, deals not so much with savings due to standardization in and of itself, but with the extent to which standardization facilitates

[1] See Chap. XII of this volume for a further discussion of these variables.

mass-production processes with their resulting economies. This approach to the problem involves quite as many theoretical and practical difficulties as the others. Sometimes it is possible to secure direct evidence by the comparison of the cost of making "specials" and "standard" products at the same time and under otherwise strictly comparable conditions. Unfortunately, very few data of this sort are available. Consequently, the material in the remainder of this chapter will be presented with the reminder that the savings attributed to standardization may be both direct and indirect, traceable and not specifically allocatable—in some cases far greater than claimed, and in some cases less.

Savings in Procurement, Due to Purchase on Standard Specifications

Plant and Equipment

While no study has ever been made of the savings achieved in any industry because of standard layout, with the object in mind of future additions, straight-line loading and standard output, some industries have made quite a point of this feature. The Bell Telephone System, for example, standardizes its plant and equipment throughout. The money savings made possible by this standard layout in shortening the time required for the building of the plant and the installation of the equipment; in the use of materials demanded in such quantities as to make possible their manufacture on mass-production basis; in the time required for operatives to learn how to manipulate standard and highly simplified (considering the complexity of the plant itself) equipment; in the complete interchangeability of equipment from plant to plant and from territory to territory, have never been computed, yet they must be considerable. The Bell officials feel that such standardization is an extremely important factor in the results which have been obtained.

The White House Baking Company standardizes its equipment and layout throughout. The company estimates the particular benefits of standardization as follows:

"As a result, we can equip a new plant and put it into efficient production in a month. When we decided to start a new plant in Stamford, we started to paint the interior on December 7. The head baker arrived from one of our other plants on January 5 at 7 A. M. In spite of the fact that he had none but inexperienced helpers, he got out a full normal day's production by 5:30 P. M. with no spoilage. He could do this because the uniform equipment and layout enabled him to follow exactly his regular routine."[1]

The first cost in building—that is, producing drawings and specifications—can be decidedly reduced by making these standard. The original cost of architects' drawings, specifications and building instructions are reduced with each re-use, the only additional cost being that of copying and printing. The following quotation gives a concrete example of this saving:

"As an illustration of the economy following from such standardization, let me say that for doctor's cottages the office cost of producing drawings and specifications have been approximately two hundred and eighty dollars. With the standards now established, this cost has been reduced to something less than fifty dollars."[2]

In the construction industries, an important item is the speed with which buildings can be safely erected, since high ground values and high original investment place a premium upon early return upon the property. Standard, mass-produced materials are not only cheaper, but they facilitate building operations. While no data are at hand as to the financial importance of this factor, it is probably very great. To this item might be added savings in insurance rates due to the use of building materials that have successfully met fire-resisting and load-stress tests.

Machine-Tool and Equipment Designs

Standard machine-tool and equipment designs are estimated to be among the most important sources of savings, both in original investment and in subsequent development. A bulletin of the American Standards Association reports a case in which, "Boring a single hole on a machine tool

[1] "Adequate Equipment is More Vital to Us Than Ever" (Summing up the Opinions of Fourteen Executives), *Factory*, February, 1925, pp. 260–265.

[2] Sullivan W. Jones, "Standardization and Hospitals." Reprinted from *State Hospital Quarterly*, May, 1924, p. 10.

saved $5,000 investment by permitting the use on that machine of tools designed for machines of another make—a saving that may be classified as due to standardization of equipment."[1]

In the Bell System, interchangeability of apparatus has always been a prime consideration in its standardization work.

> "This is important from the standpoint of dimensions; for example, transmitters are so designed as to fit into any mounting even though made a good many years previously. In a broader sense, considerations of interchangeability lead to the design of new standards in such a way as to fit into existing plant with the minimum possible change in the other items of the plant."[2]

Numerous advantages of direct pecuniary significance are claimed for standardization of design and layout. The scrap value of parts of worn out equipment, the individual parts of which may be a little worn and, in some cases, as good as new, is enhanced if the parts are standard and re-usable. The sale of standard equipment, or the sales value of a plant having standard equipment, is promoted by the fact of the standards. Thomas Maddock's Sons' Company makes an interesting statement along this line:

> "Twenty-seven carloads of molds went to the scrap heap as the result of our adoption of a standardization policy. Most of these molds were carried on our books at a high figure and they cost us a pretty penny, too. Now our molds have a value—every one of them. If we were to sell out tomorrow they could be fully realized upon, for they are standard."[3]

While standardization has made considerable headway in the milling machine field, much remains to be done before real interchangeability for cutting tools and fixtures on machines of different makes is realized. Such units as mountings for cutting tools, motor frames, collets and spindle noses, face plates, tables, etc., can be standardized to great advantage.

[1] *Sustaining Members Bulletin, op. cit.*, Aug. 20, 1928.

[2] "Standardization in the Bell System," a special report prepared by the Bell Telephone System for the National Industrial Conference Board, 1928, p. 5.

[3] A. M. Maddock, "How Simplification Removed Production Difficulties," *Factory*, November, 1921, pp. 612–614.

Purchase upon Specifications

The use of specifications in the purchase of raw materials, semi-finished or finished materials, tools, machinery or other equipment is held to possess numerous definite pecuniary advantages. The Federal Government, it has been estimated, saves $100,000,000 [1] a year by this means. The use of definite purchase specifications has enabled the government to ignore trade and brand monopolies and to secure competitive bids on materials. This has had the tendency, in nearly every case, to lower the price of commodities to the Government. The same advantage has accrued to those private business firms, both producer and consumer, which have made use of specifications. An example of these savings is afforded by the following case:

> "A well-known manufacturer of parts supplied a score or more of automobile companies. Each one bought from 10,000 to 500,000 parts a year, but each wanted some minor variation in the pattern. The constant change in machine set-up necessitated by these varying demands kept the parts-manufacturer's plant in confusion. He was practically operating on a job-shop basis, although his total output was large enough to warrant quantity-production economies.
>
> "Careful figuring showed him that he could cut his price in half, improve his delivery service and yet make more money himself, if he could induce all his customers to accept the same pattern. He laid the facts before them. They accepted the proposal. One of them saved $4,000,000 a year, or $20 a part on 200,000 parts."[2]

The Detroit Edison Company saved $1,800 on a single $4,000 transaction by the use of purchase specifications.[3] "One large rubber company saves $10,000 a year on the single item of the valves it uses, by purchasing on performance tests and specifications rather than under brand names."[4] The Bell Telephone System realized a saving of $50,000 a year on the purchase of $150,000 worth of black lead pencils, which they attribute to standardization. The same company "estimated that without the standardization of directory paper and the bulk purchasing which this enables, the

[1] Division of Simplified Practice, *Monthly News Bulletin*, Mar. 15, 1927.

[2] *Ibid.*, June 15, 1928.

[3] Stuart Chase and F. J. Schlink, "Your Money's Worth," New York, 1928, p. 232.

[4] *Idem.*

same quality of paper would cost the Bell System about $800,000 more per year."[1]

Before the drawing of specifications for the purchase of materials, the Western Electric Company, the purchasing and producing branch of the Bell System, makes a study of the market, the methods of manufacture and the properties of the materials incorporated into the manufactured product, in order "to know our materials and build from elements of unit cost up to a fair value equivalent rather than attempt to trade down the value equivalent arbitrarily set up by the sellers."[2] To this policy they attribute important savings of the type mentioned above.

These examples of estimated savings are typical of a vast number of business testimonials that have been made from time to time by representatives of different types of enterprises. But aside from direct money savings due to purchase on standards and specifications, there are several other advantages of pecuniary significance not so easily estimated in money terms.[3] Technical specifications, which eliminate hazy, indefinite and controversial terms, are held to eliminate one of the most important sources of litigation in business.[4]

Perhaps more important as a potential source of savings is the use of specifications in the purchase of materials for the upkeep and maintenance of buildings, machinery and other equipment. The American Petroleum Institute recommends that buyers "use only vegetable castor oil on belts other than leather, and then only at such time as it becomes absolutely necessary," unless a different belt dressing is specifically recommended by the manufacturer.[5] There are scores of patented belt dressings on the market. The recommended castor oil for rubber and other belts and neatsfoot oil for leather belts are obtainable at a fraction of the cost of the patented dressings and are very economical,

[1] "Standardization in the Bell System," *op. cit.*, p. 29. [2] *Ibid.*, p. 32.

[3] L. R. Watkins, "The Analysis of Prices," an address delivered before the National Association of Purchasing Agents at Kansas City, 1928, p. 7.

[4] See, P. G. Agnew, "How Business is Policing Itself," *The Nation's Business*, December, 1925, pp. 41–43.

[5] A. H. Riney, "Belting Committee Had Difficult Task," *Oil and Gas Journal*, Sept. 22, 1927, p. 18.

since American Petroleum Institute instructions call for a minimum possible use of the material.

Cleaning and sweeping compounds, floor and furniture waxes and polishers, soaps, cleaners and other detergents, and other building, office and factory supplies, sometimes are purchased for but a fraction of the quoted market price when bought on specifications. A Chicago Y.M.C.A. made a liquid soap—"a better grade" than the commercial equivalent selling for $1 a gallon—for a price of eleven cents a gallon.[1] The National Building Owners and Managers Association has recently instituted a program looking towards the establishment of recommended purchase specifications for buildings and office maintenance supplies. On the positive side, they expect to realize important savings by reduced purchase prices. On the negative side, they expect materially to increase the life of building furniture, materials and equipment by using cleaning and polishing compounds that do not harm the cleansed or polished surface. Bad polishing compounds, for example, are said to have shortened the life of certain marbles by half by permitting the formation of salts in the pores of the marble, not only spoiling the polish but in some cases actually necessitating replacement. The same is true of floor surfaces, furniture finishes, plumbing and lighting equipment, etc.

While it is very difficult to obtain reliable figures, important savings indirectly due to standard specifications are claimed in the opening up of uses for sub-standard goods, purchasable for considerable less than the price of the standard goods. Sub-standard railroad ties and rails can be used for little-used switches and sidings, sub-standard brick and building materials can be used for temporary structures, or stuctures where the loads are comparatively small.

Reduction of Salvage Costs

Another saving, very important in some industries, is the reduction of salvage costs by the purchase of materials to fit a standard design. The Ford Motor Company found that it saved by this process $3,000,000 a year, or the wages

[1] Chase and Schlink, *op. cit.*, p. 90.

of 2,000 men, by preventing 80,000,000 pounds of steel from going to the scrap pile. A great deal of the savings realized by the Ford Motor Company is made by means of improved design through standardization.[1] The experience of the company is sufficiently illuminating to be worth quoting at length:

> "We formerly cut our crank cases out of trimmed steel plate exactly the width and length of the case. That steel cost \$.0335 per pound because it had in it a good deal of labour. Now we buy an untrimmed sheet 150 inches long at \$.028 per pound, shear it to 109 inches—sheared portion going to make another part—and on the remaining plate we can lay our five crank cases, which are cut in one operation. This saves four million pounds of steel scrap a year, and the whole saving amounts to nearly half a million dollars. The windshield bracket is somewhat irregularly shaped, and we formerly cut it from 18 x 32½ inch rectangular steel sheets. A sheet gave us six brackets and a quantity of scrap. Now, by taking stock 15½ x 32½ inches cut at a seven-degree angle, we get six windshield brackets as before, but also in the same operation we get ten other blanks for small parts. This saves a million and a half pounds of steel a year. The oil-can holder is in the shape of a cross, and we formerly stamped it out of steel with great waste at a cost of \$.0635 each. Now we cut the two parts of the cross separately with almost no scrap and weld them together, and they now cost \$.0478 each."[2]

Savings Due to Standardization through the Reduction of Stocks and Inventories

Most obvious, because most easy to isolate, are the savings from standardization of stocks and inventories. These savings flow directly from the simplification of stock and from purchase according to standards and specifications.

Reduction of Capital and Increase in Turnover

The reduction of the amount of capital tied up in stocks and inventories results in savings of two sorts. In the first place, the absence of slow-moving and seldom-used material reduces the absolute amount of invested capital. In the second place, the more rapid use of the standard stocks makes possible a more rapid turn-over of the capital tied up. It is even possible, in some cases, practically to eliminate certain types of stocks by scheduling delivery as the supplies

[1] H. Ford, "Today and Tomorrow," New York, 1924, p. 91. [2] *Ibid.*, p. 92.

are needed. The manufacturer of the supplies is willing to do this if he knows that definite amounts will be taken at definite time intervals.

The reduction of investment tied up in stocks and inventories may be realized on raw materials, materials semi-finished in the process of manufacture, and materials and products finished and ready for shipment. Some of the most interesting examples of savings along this line are to be found in the standardization of office supplies. The Western Maryland Railway Company according to M. E. Towner, General Purchasing Agent, "by standardizing their stationery and printing, including ink, pens, pencils and other office items, has reduced the stationery and printing bill of the road by from $110,000 to $65,000 per year."[1] Another illustration is provided by the Great Northern Railroad:

> "An investigation concluded by a special committee of nine department heads of the Great Northern Railroad has resulted in a $55,000 reduction in that railroad's expenditures for stationery. The committee, which carried on its investigation for 18 months, examined 3,689 forms of stationery; of these forms, 379 were found to be obsolete or out of use, 651 were consolidated and 1,980 were revised, leaving only 679 forms which were not altered. Savings were made by standardizing sizes, reducing varieties and cheapening the quality of the paper stock where possible."[2]

The State of New York reports a reduction of its printing bill, due to size standardization, of $450,000 a year.[3] A large percentage of this, as with the above cases, is due to the reduction of inventories. A large chain hotel company reported the release of $350,000 from former inventories, through simplification of glassware, carpets, table linen and 200 other supply items.[4]

By standardization and the manufacture of interchangeable parts, the Remington Arms Company, Inc., reduced inventories 65% and warehouse space 42%.[5] The Morgan

[1] *Monthly News Bulletin*, *op. cit.*, Nov. 15, 1927.
[2] *Ibid.*, Oct. 15, 1927

[3] *Sustaining Members Bulletin*, *op. cit.*, Jan. 3, 1927.

[4] William Chattin Wetherill, "The Elimination of Waste in Industry," reprinted from the *Journal of the Franklin Institute*, July, 1926, p. 14, quoting L. M. Boomer, President, Waldorf-Astoria, Inc.

[5] *Idem.*

Construction Company found that standardization reduced its inventories by 58%.[1] It is stated that:

> "One large manufacturer of rigs and derricks and rig irons who has over three and one-half millions dollars invested in inventory, estimates that with the complete adoption of A. P. I. standards, their investment would be reduced to considerably less than two million dollars."[2]

Instances of savings of this sort due to standardization could be multiplied almost indefinitely.

Simplification of Stock Room

In addition to the interest upon released capital and the increased turnover of capital, standardization simplifies the stock room and reduces the total storage space necessary. Many illustrations are available of decided decrease in space used for stores following standardization. It is often hard to determine how important an item this is. One writer finds that 3% a month is the carrying charge on warehouse goods,[3] while a large public utility company finds that the warehouse expense equals about 12% of the cost of the materials when finally taken from storage for use. On an inventory of $100,000, this means an addition of $12,000 to cost. On this basis a saving of 45% on space means an annual saving of $5,400.

Another saving, of a somewhat different sort, can be attributed to standardization of stocks—the elimination of stocks whose value, represented as tied-up assets, must in course of time be written off the books because of complete, or almost complete, lack of demand for the odd sizes, shapes, and equipment. The following is a typical instance:

> "A fairly successful publishing house in one of our large cities does its buying by the unsystematized fashion. Last year in making up its statement of profit and loss, the inventory of paper amounted to $20,000. Three-fourths of this paper exists as overruns, or odds and ends of lots which are stored in various printing offices and cannot be used on an average-sized job. They are so scattered they cannot be combined, and the make, color, finish, and size are different in

[1] *Sustaining Members Bulletin*, *op. cit.*, July 12, 1928.

[2] American Petroleum Institute, Standardization Bulletin, No. 101, New York, 1928, p. 54.

[3] O. J. Roberts, "The Benefits of Standardization," *The Rubber Age*, July 25, 1928, pp. 435–436.

> nearly all the lots. When this house realizes what this stock is, it will be forced to write off nearly $15,000 from its books on what it now considers good assets."[1]

The more slowly stocks move, the more nearly they approach this example of dead assets. The more rapidly they move, the better they are as assets. In this fact lies the significance of a great deal of the work of the Division of Simplified Practice. The literature of the Division is replete with examples of the pecuniary advantages of the elimination of slow-moving stocks, and of the extent to which simplification, by fixing upon products in greatest demand, increases the turnover of stocks in hand. One manufacturer is reported to have been able, through simplification of stocks, "to do a $4,000,000 annual business on a $176,000 inventory in contrast with a previous $1,600,000 business on a $500,000 inventory, thus increasing his capital turnover from 3.2 to 22.7 times per year."[2] Another firm found it could double output and triple earnings on $100,000 less inventory as a result of the introduction of production control methods, a basic feature of which was standard purchase specifications.[3]

The simplification of stocks frequently, and probably usually, results in a decrease in stock-room personnel, making possible a saving on the stock-room wage bill. While no figures are available stating such savings in definite terms, still the indications are that in many cases the figures, if known, would be significant.

Computed as a grand total for industry at large, the savings due to the reduction of stocks and inventories through standardization would probably be very great. A Bulletin of the International Management Institute summarizes a report of the American Railroad Association, sixth division (stores and purchases) as having "reached the conclusion that 10% of the total amount of American Purchases is saved by the purchase of simplified stocks."[4]

[1] H. P. Kendall, "Unsystematized, Systematized, and Scientific Management," from *Business Administration*, edited by L. C. Marshall, Chicago, 1921, p. 374.

[2] Paul E. Holden, "Intra-Plant Standardization," *Annals*, *op. cit.*, May, 1928, p. 119.

[3] William L. Walker, "Double Output, Triple Earnings, $100,000 Less Inventory," *Manufacturing Industries*, December, 1927, pp. 457–459.

[4] *Bulletin of the International Management Institute*, *op. cit.*, February, 1928.

Savings Due to Standardization of Processes of Production

Savings due to standardization of processes of production are difficult to isolate from numerous other factors. Here, if anywhere, it is practically impossible to make any logical separation of savings due to mass production, to science and invention, and to standardization. In fact, the material is of such a nature that it seems wisest to indicate only the extent to which the adoption of standards and the application of standardization techniques have enabled manufacturers and producers to take advantage of the savings due to the economies of mass production. A few examples will show the character of these savings.

> "Our standard steel-window shop . . . offers an example of what I mean by taking full advantage of standardization. Production moves more slowly in our special shop than in our standard shop, because in a special shop each job must carry its own identity. A separate bill of material must be made up for each order, and it must be routed and scheduled and take its turn at machines. In the standard shop, however, no sash has any individual identity. Materials are standard, processes are standard, and the machine work is continuous. Under these circumstances, if, for accounting reasons or for any other purpose, we were to assign job-order numbers or otherwise identify our standard windows in process, we would be failing to take full advantage of the possibilities of standardization."[1]

* * *

> "How the specialty work tends to increase cost of production is illustrated by another speaker who told of an order for 75 special backs (piano backs) that meant a decrease in production in his company's plant from 100 to 125 backs a day to 75 in a day and a half, at the same time necessitating changes in process and extra pay and creating numerous annoyances to the working organization. This speaker asserted that 10 per cent extra cost was a conservative estimate and charge to make for special work of this type."[2]

* * *

> "There have been times when business was booming that the large steel companies would not consider, except on very long delivery, an order for 100 tons of a special size of steel shafting, for example, because this meant the derangement of their mill schedules where they were producing standard stock in the order of thousands of tons."[3]

[1] T. H. Kane, Vice-President and Works Manager, Truscon Steel Company, "How Our Factory Works Hand in Hand with Our Sales Department," *Factory*, April, 1925, p. 583.

[2] Alfred L. Smith, "Simplification in Industry," *Factory*, June 15, 1921, p. 1391.

[3] C. E. Skinner, "Why Standardize?" (unpublished paper), Aug. 10, 1923.

Standardized production processes require, in the first instance, standard building design, layout and equipment, discussed above. The Bell System estimated that it saved, through uniform column spacing, approximately 50% of the cost of the constructing and erecting of metal partitions in its Kearny, New Jersey, manufacturing plant.[1] The Firestone Tire and Rubber Company found that, "With only one product, every unit of that product must go through every operation in the factory, and it is possible to plan once and for all the best sequence of operations, the best factory layout, the best routing plan."[2]

Standardization of Equipment

The Bell System found that the standardization of "manufacturing equipment, such as shop benches, lockers, racks, trucks, etc.,"[3] saved floor space, reduced the work of preparing manufacturing layouts, and made possible their manufacture on a cheap quantity production basis. Standardization of machines brought advantages which included, "lower first cost because of volume buying, ease in applying standard safety measures, adaptability to standardized processes, adaptability for use with standardized associated equipment, such as benches and trucks, flexibility of machine equipment to meet peak loads, and interchangeability of machine parts, which facilitates maintenance."[4] Similar advantages resulted from the manufacture of standardized parts.

All these advantages, ultimately resolvable into financial savings, are advantages because they permit of continuous, straight-line production. As has been aptly stated, "A properly organized factory is a smoothly running machine, designed for a special purpose. Throwing a new form of product into that machine causes a mass of disorganization which it is almost impossible to measure."[5] Disorganization of this sort costs money; in some industries such stoppages

[1] "Standardization in the Bell System," *op. cit.*, p. 17.

[2] Harvey S. Firestone, President, Firestone Tire & Rubber Co., "Why We Invested $7,000,000 in Simplification," *Factory*, December, 1921, pp. 739–743.

[3] "Standardization in the Bell System," *op. cit.*, p. 17. [4] *Ibid.*, p. 18.

[5] A. M. Simmons, "Production Management," *Business Management Series*, American Technical Society, Chicago, 1922, p. 86.

are almost disastrous. The experience of the American Writing Paper Company is interesting in this connection:

"With frequent shortness of runs, the mill men cannot even make an attempt to work up production to a maximum because the attention of this superintendent and crew becomes diverted and has to be devoted to getting the minor product right in its general characteristics, formation, color, and so on, and loss of the paper run off experimentally results. By the time it gets to running to the satisfaction of the crew, it will be time to change to some other order. Frequent rejections in quality were experienced, as a result of short runs.

"Usually a half-hour or so is required merely to start the end of the paper through the labyrinth of drying rolls at the end of the machine. Meanwhile heaps of 'broke' or waste paper accumulate. But this heap is only a symptom. Adjustments for fibre formation and for uniform thickness, and so on, require time and pains. The principal spoilage of paper comes at the beginning of a run. It takes several hours to get a run going in a proper way."[1]

Another type of cost, which standardization of process, through standardization of product, would eliminate, is illustrated by the following experience of the Westinghouse Electric Company:

"We not infrequently receive orders for special alloys, these special alloys being called for by our customers. A notable example of this is the special babbitt which was called for by . . . [one of our customers]. We endeavored for years to get this changed to our standard babbitt, but without success. The result is that we have had to make up a special lot of babbitt, and on account of the characteristics of this particular material it is much more difficult to handle than our standard babbitt, and so far as we have been able to follow it out, it is not one whit more satisfactory. The labor involved in making bearings with this material is several times that of our standard babbitt, due to its sluggishness and the number of defective bearings which result therefrom. The scrap from this bearing metal is very difficult to keep separate from our standard babbitt, consequently there is likely to be a contamination of our standard material in spite of the precautions which can be taken, with a resulting deterioration of our standard stock. Here is another case where it is impossible to cover the actual increased cost of the special material as compared to that of our standard material."[2]

According to an engineer, " . . it has been estimated in specific cases that manufacturing costs of an individual

[1] George A. Galliver, President, American Writing Paper Co., "12 Savings We Have Made," *Factory*, October, 1921, pp. 463–466.

[2] "Why Standardize?" *op. cit.*

special piece of apparatus will be from 15 to 50 per cent in excess of that of a standard type of essentially the same capacity and characteristics which is manufactured in quantity production."[1] One company found that the production of specials was adding materially to the cost of the production of standard goods. Accordingly, a separate factory was erected to take care of this type of business. Careful cost analysis proved that specials could be more economically manufactured in a factory designed to meet the needs of that type of production, but that in order to make such production profitable in itself, instead of being parasitic upon the standard product, it was necessary "to raise the prices so much that they finally found it necessary to close the special factory."[2]

Decrease in Number of Workers

Another saving due to the standardization of production processes, equally difficult to estimate in precise monetary terms, is that which results from a decrease in the working force or a change in its character through a substitution of unskilled labor for skilled, made possible by the introduction of automatic machinery. Generally, either change means a shift in the operating ratio by way of an addition to the fixed costs. Overhead costs, or those costs that tend to vary relatively little with output, increase relatively to variable costs, or over former overhead. This, of course, is a decided advantage as long as the average of variable costs decreases at a more rapid rate than the overhead increases. Labor is not the only variable factor that may affect the cost structure in this fashion. A change of the power source from a private steam heating plant to electric power purchased for the maximum of production at a flat rate has changed a former partially variable cost into an overhead cost.

But however significant such shifts in the cost structure may be for the individual firm, there are few data that will serve for a yardstick of their pecuniary significance. Con-

[1] E. C. Stone, Planning Engineer, Duquesne Light Co., Pittsburgh, "Standardization and Progress," *Electrical World*, May, 1926.

[2] P. G. Agnew, in letter to Dr. E. C. McGuire, June 19, 1923, files of the American Standards Association.

tinuous production of standard goods, of course, has the tendency to lower the unit overhead cost. However expensive the installation of standardization of processes may be in substituting automatic machinery for semi-automatic machinery or craftsmanship, it is the unit cost that counts. It is to standardization that the Ford, General Motors, Firestone Companies, etc., attribute their ability to use the elaborate and very expensive conveyor systems that have become so characteristic of these industries. In 1925, because of the mass output of a standard product, the Ford Motor Company was able to add ninety boring mills to the previous 200, even though these cost the company $15,000 each. "When hundreds of thousands, and even millions, of parts can be made all alike, no expense for tool equipment becomes too great, provided gains can be made in speed and accuracy in the product."[1]

Increased Productivity of Labor

The effect of automatic production upon the character of the working force is almost too well known to need elaboration here. The enormous increases in productivity per man-hour, or per dollar-wage in the United States in recent years is a matter which by this time is known to every schoolboy. The general effect of the introduction of the automatic machine is to make what was formerly a handicraft or semi-handicraft product, a machine product. The craftsman becomes either the unskilled attendant, that is, unskilled except with reference to the operation of the machine, or a mechanic. These shifts in the plant personnel have had the general effect of very decidedly reducing the wage bill per unit of output. These savings can be attributed in large part to the introduction of process standardization.

Decreased Cost of Accidents

While there is no settled argument on this issue, it seems to be now widely accepted that even though increased production has been accompanied by increased cost of accidents in terms of man-hours or payroll, there is a decided decrease

[1] "Why Standardize?" *op. cit.*

in cost of accidents in terms of production. A recent report of the American Engineering Council states that:

> "The rate of change in production per man-hour for the industrial groups studied is greater than the rate of change in accident frequency per man-hour or the rate of change in accident severity per man-hour. Quantitatively, the production rate was 14.4 per cent higher in 1925 than in 1922, the accident-frequency rate 10.4 per cent lower in 1925 than in 1922, and the accident-severity rate 2.5 per cent higher in 1925 than in 1922."[1]

The conclusion is drawn by the Engineering Council that the efficient factory is the safe factory.[2] Actual savings from standard safety provisions for standardized production processes might presumably be demonstrated by contrasting the accident experience of a firm before and after the introduction of such standards. Another method might be to make a study of otherwise comparable industries not working under the same standard conditions. Some appreciation of the significance of savings from this source may be gained when it is realized that accident compensation ranges from 2% to 30% of the total wage bill in different branches of the building industry.[3] The elimination of this cost, of course, is a problem that must be solved by the entire industry, not by an individual manufacturer or builder.

[1] American Engineering Council, "Safety and Production," New York, 1928, p. 35.

[2] It should be remembered, however, that the figures here adduced do not show that the efficient plant is *safer for the operative*, but that its increased productivity lowers the accident *cost* to the management.

[3] Ethelbert Stewart, U. S. Commissioner of Labor Statistics, "In New York the rate on structural iron workers is practically $33 per hundred dollars of payroll, or one-third of the wages. This means that since the New York City rate of wages for structural steel workers is $12 a day, the workmen's compensation premium is $3 per man per day. . . . If we can take the District of Columbia's experience as typical, the hazard in demolition is much greater than in construction. This belief is further borne out by the premium rate of the Ohio Industrial Commission, which is $18 per hundred dollars of payroll for building wreckers, and $6 for building movers other than wooden, while the rate for building movers, wooden, is $8.50 per hundred dollars of payroll. The New York rate on demolition is even higher, namely, $36.02 on each one hundred dollars of payroll." Paper read before the Twelfth New York Industrial Safety Congress and Exhibit, Syracuse, N. Y., December 3–6, 1928, pp. 1, 2.

L. L. Hall, of the National Council on Compensation Insurance, submitted at the Conference on Proposed Safety Rules for Construction Industries, held in New York City, June 29, 1928, the following figures (covering policy years 1920–1924 inclusive, reckoned on the basis of the New York Compensation Law of January 1, 1927): Iron and steel construction, $24.93; road construction, $5.22; plumbing, $2.31; carpentry, $17.11; carpentry—private residences, $4.14; masonry, $6.62; wrecking—not marine, $30.02.

Standardization of machinery, equipment and methods of instruction makes possible the issuance of books, pamphlets, leaflets or standard instruction sheets for the information and guidance of workmen, and for breaking in new men and giving them an accurate working knowledge of the job. The Bell System finds that this facilitates the work of installation, construction and repair. "It is common practice, in cases of emergency due to large storm damage or other causes, temporarily to concentrate in one small area construction gangs from a number of different operating companies. These men have no difficulty with the work in a new area because of the uniform construction practices in use throughout the country."[1]

In long distance toll operations, standardization of methods of putting through calls is as essential as the standardization of equipment. Standard operating practices are developed for different types of local exchange service, "such as flat rate, message rate, coin box, individual or party line service, etc.," and the specialized services.

> "The practices specify in detail the procedure to be followed by operators in handling these various types of calls, and in general specify also the phraseology to be used by the operators, with a view to insuring maximum accuracy, clearness and convenience to the subscribers."[2]

This type of standardization is very closely related to what is generally called "scientific management," or the standardization of the job of the individual operative, following time and motion studies. While it is impossible to draw a sharp line between scientific management and technological standardization and, at the present time, at any rate, to evaluate the precise pecuniary significance of either, business men, managers and engineers are unanimous in the belief that standardization of the conditions and the routine of the individual job plays no small part in the steadily increasing industrial efficiency with which all are familiar.

Regularization of Production

Perhaps more important than savings due to routinization of the job itself is the effect of standardization in decreasing

[1] "Standardization in the Bell System," *op. cit.*, p. 26. [2] *Ibid.*, p. 28.

labor turnover and regularizing production. The ability to manufacture to stock, during periods of seasonal or cyclical depression, has a tendency to regularize employment for the worker and to decrease the rate of labor turnover. Standardized products enable manufacturers to produce to stock in time of business depression, because of the practically certain knowledge of a market some time in the future. Where this is possible, it means a better average utilization of plant and equipment and, consequently, a lower overhead charge per unit of output. This would be true whatever the regularizing force, or whatever the type of business fluctuation partially or wholly eliminated. In some cases, industries of a pronounced seasonal character have, through standardization of the product, established production on a uniform yearly basis. For example:

> "Shoe manufacturers in Maine made a careful study of their need for cardboard boxes and found that their requirements could be filled by a limited number of standard sizes. They then acquired control of a local box company, and standardized its output to meet their particular needs, establishing cost prices for all standard size boxes. Ninety per cent of the plant output is now limited to standard sizes and the machines once set, run the year round without a change. Standardization has made it possible to stock up sufficiently to meet emergency demands."[1]

The American Writing Paper Company found that standardization was instrumental in preventing shut-downs.[2] One of the principal difficulties in the electric manufacturing industries has been the fact that the large percentage of special orders has not enabled them to manufacture to stock in times of slack demand. A partial solution has been found for the difficulty by the manufacture to stock of a large percentage of the component parts of electric motors, both standard and special.

To the extent to which this can be achieved in this and other industries, standardization is responsible for important and significant savings and will also aid in reducing the labor turnover in industries of a pronounced seasonal character and in industries greatly affected by cyclical fluctuations. To the extent to which standardization can be held to facilitate the

[1] *Sustaining Members Bulletin*, *op. cit.*, July 12, 1928.

[2] George A. Galliver, *op. cit.*, pp. 463–466.

regularization of business, it can be held to have saved on this cost of high labor turnover.[1]

Another important factor influencing high labor turnover, as well as general efficiency on the job, is the employee-employer relationship. Standardization may influence this relationship in several ways. One of the most interesting of these is the standardization of labor terms. Such terms as "quit," "layoff," "discharge," "absence," "strike," etc., create a great deal of confusion, uncertainty and ill-will, which are in the long run of considerable significance from the point of view of the efficient operation and profitableness of a plant.[2] Much more significant, however, is the enlisting of the employees in the task of eliminating uneconomic practices and in the saving and better utilization of materials.

Elimination of Breakdowns

Standard tasks enable both credit for efficient operation and blame for failure to be fixed where they belong. Breakdowns necessitating repairs become of less consequence when standard, interchangeable repair parts are at hand. Where workers are paid on a piece-rate basis, this is of considerable importance. Furthermore, the very fact that standardization makes the job safer, systematizes and clarifies the character of the work, and tends, in the long run, to regularize production, means that the company is able to hire and retain for a longer period high-grade and efficient workmen. The realization on the part of the employees that unsystematic, uncoordinated and haphazard methods of production are wasteful and expensive has made them very receptive to suggestions for standardization, when enlightened managerial policies offer them a share in the savings to be realized by the change. It is frequently claimed in support of this thesis that the most highly standardized industries, such as the automobile, telephone and telegraph, steel, railroad, electric manufacturing and distributing and machine tool industries, are among the highest wage paying industries in the United States. The American Federation of Labor is

[1] See Chap. XIV of this volume for a further discussion of these issues.

[2] See, J. D. Hackett, "Clearing Up the Uncertainty of Labor Terms," *Management Engineering*, May, 1923, p. 341.

now actively endorsing cooperation of this type.[1] It is impossible to estimate these savings in money terms as yet.

Standard Cost Accounting Systems

Standardization of manufacturing processes makes possible, finally, the establishment of a standard and reliable cost accounting system. While it is probable that at the present stage of development of cost accounting techniques no amount of standardization could entirely eliminate the element of arbitrary cost allocation, evidence seems to support the view that, without standardization of some sort, cost accounting would be almost, if not completely (in some, if not most, industries), impossible. In the construction, printing and other industries where the work is done almost entirely on a job-lot basis following a successful bid, accurate cost accounting—involving a clear foreknowledge of quantities, qualities, and prices—is absolutely necessary in order to enable the bidder to steer a successful course between the Scylla of the too high bid, and the Charybdis of bankruptcy because of too low estimates.[2]

Savings Due to the Production of a Standard Commodity

Every saving made in business is equivalent, in the long run, to a like addition to profits. Profits, broadly speaking, are a product of two variables: the margin between cost price and selling price, and the volume of sales. A careful buying policy, based largely on purchase specifications, and a close knit, efficient, and highly standardized system of production represent the contributions standardization can make to low cost business. The profit margins will depend largely upon the volume of output. If the volume of output is small and the turnover of stocks slow, the profit margin must of necessity be wide. If the volume of output is large and the turnover of stocks rapid, the profit margin can safely (profitably) become very narrow.

[1] See, for example, a labor symposium on waste elimination, in the *American Federationist*, June, 1927.

[2] See, for example, Russell A. Pettengill, "Standards in the Printing Industry," *Annals*, *op. cit.*, May, 1928, pp. 157–167.

So widely has this fact become recognized by business men that such a generalization can be recognized as a business aphorism. The most common expression of faith in this article of common-sense business wisdom has been incontinent indulgence in sales competition. The object has been to extend the market at all costs in order to be able to "cash in" on certain, almost mythical "economies of mass production." But at all "costs" has covered up a multitude of sins that have narrowed the profit margin further than is necessary in many cases, and eliminated the business firm entirely in others. Among these costs are those attendant upon the excessive multiplication of varieties, sizes and designs, the loss of market through advertising misrepresentation, lowered standards of quality, etc.

In other words, the economies of mass production can only be realized when certain policies and practices are followed out. Under competitive conditions at least, these conditioning factors look towards a more complete and efficient utilization of present and prospective plant, equipment and personnel. More continuous production of the same commodities rather than the constantly interrupted processing of numerous and frequently little used commodities is the beginning of wisdom for the would-be efficient plant.

Considered as such, it is impossible to separate savings due to standardized output from savings due to standard processes and the purchase of materials on specifications. Without one the other is not possible. Yet it is convenient to look at the matter from the angle of the standard product, because this brings into sharp relief certain otherwise obscure elements of the problem of industrial standardization.

The Division of Simplified Practice has fastened upon simplification, or standardization of type, as the most fruitful source of immediate savings to business. Appendix E of this study gives a summary of the material advantages accruing to business through simplification, as reported by the Division.

Among the material advantages of distinct and immediate monetary significance is the effect of the standardization of product upon domestic and foreign markets. The automobile, electric light, electrical equipment, phonograph, radio,

etc., are examples of the extent to which standard, low-cost, low-priced products have been sold in such enormous quantities that narrow profit margins have brought in significant net profits. The standardization of sizes and styles of electric lamp bases has made possible concentration in manufacture upon a few types, now produced so cheaply that even the poorest can afford what was formerly only to be had by the rich.

Standards of grade, quality and size are of course necessary in order to build up and maintain national or international price quotations and market news services. Produce and raw material exchanges are almost inconceivable except on a basis of standards. Further standardization in different lines of farm produce should widen the market still further.

Where the product sold is a service, rather than a commodity, uniform service conditions have important effects upon other industries. Electrical devices for household use, for example, are much more widely used in the United States than in any foreign country, largely because power plants and distributing stations have standardized their voltages, frequencies, and type of current to a much greater degree here than abroad. An interesting case along this line may be cited:

> "In the city of London alone, in the past, there have been a large number of relatively small plants different both in frequency and voltage, and this has done much to retard the use of electrical devices in the London area. If one moved from one district to another, an entirely new set of devices might be required. Plans are on foot for adopting a standard voltage and frequency for this district which will mean the scrapping of much of existing equipment."[1]

Standardization and Foreign Trade

The effect of standards upon foreign trade is very great. The existence of definite standards and specifications for materials and manufactured machinery and equipment has the effect of facilitating purchase abroad, both because of the lower price of standardized products and the elimination of uncertainty as to the character of the goods purchased. Mr. Marcus L. Wallenberg, Sweden, regards the grade-

[1] C. E. Skinner, "The Present Status of Standards in the Electrical Industry," *Annals, op. cit.*, May, 1928, p. 154.

marking of Swedish lumber as "the back-bone of the industry because consumers of Swedish lumber, in practically every country of the world, know that the quality of Swedish lumber is as represented by the grade-marks."[1] The recent success of the German electrical industry, as the world's largest exporter of electrical equipment, has been attributed, in part, to the existence of standardization practices in Germany on a more wide-spread and thorough basis than elsewhere.[2]

A recent number of the *Iron and Coal Trades Review* (London) complains of the loss of large steel orders by English manufacturers, resulting from the purchase of steel by the South African Government Railways in accordance with foreign specifications:

> ". . . the High Commissioner for the Union of South Africa has issued invitations to various firms to tender for a quantity of locomotive boiler firebox and miscellaneous plates specified to be in accordance with the requirements of the American Standard (ASTM) Specifications for material of this nature, and with the following objectional proviso:
>
> "'The plates must be obtained from one or other of the following approved makers.'"[3]

Another example of somewhat the same general character is supplied by the London Times Trade Supplement:[4]

> "The United States share of the Indian import trade is 5.8 per cent, as against 2.6 before the war. The principal imports in order of importance last year were mineral oils, machinery, motor vehicles, hardware and tools, tinplates, provisions (mainly bottled or tinned), instruments and apparatus (mainly electrical), and toilet requisites. The success of American exporters is greatest in those articles in which standardization and mass production have brought prices down to the reach of the Indian market, as in the case of motor vehicles, typewriters, and certain types of machinery and tools."

Cases of this sort might be cited almost indefinitely. While, as in the case of domestic commerce, the evidence is not always clear regarding the extent and manner in which stan-

[1] Quoted in *Monthly News Bulletin*, *op. cit.*, Aug. 15, 1928.

[2] See, U. S. Department of Commerce, "Exports of Electrical Equipment from Germany, 1912–1927," Trade Information Bulletin, No. 548.

[3] Here follow the names of seven American manufacturers of steel plates. *Sustaining Members Bulletin*, *op. cit.*, July 12, 1928.

[4] *Ibid.*, Sept. 15, 1926.

dards affect foreign trade, the result seems to be decidedly salutary. Not least among the advantages of standardization to the manufacturer and exporter in gaining a wider market are those to be set down to the credit of adequate servicing through standard interchangeable parts. The Singer Manufacturing Company, producer of sewing machines, is able through a rigid standard gage system to assemble machines from any of their plants in different parts of the world. Singer repair parts, wherever bought, will fit. The same is true of Ford and General Motors automobiles.

Maintenance of Home Markets

Definite standards are sometimes necessary in order to maintain home markets. East coast cities have recently begun to buy quite heavily in the foreign steel market. In the attempt to check steel importation, American steel manufacturers are attempting to compel "importers to undergo tests of standardization sufficient to take up some of the wide price margin now existing between the lowest level at which merchants can profitably sell American-made steel and the highly advantageous level at which unrestricted importers can sell European-made products here."[1] A large American electrical manufacturing firm has recently sent an expert to Europe for the specific purpose of showing European manufacturers, particularly the German manufacturers, the methods of American manufacture of electric light bulbs. The object is to bring the standards of manufacture abroad up to the point where the product is on a par with the American bulb, and thus prevent the importation into this country of cheaply made and inefficient bulbs, which have been undermining the domestic market. While sold more cheaply, the foreign bulbs have been much more expensive in terms of the average life of the bulb and the illumination per unit of energy used.

Still more striking is the endeavor to establish standards in order to prevent the total loss of a market in cases where goods or equipment are competing on a commodity basis. The makers of ice refrigerators and the ice dealers are cooper-

[1] *New York Times*, May 30, 1928, quoting Allen E. Beals from the Dow Service daily building reports.

ating in the endeavor to establish rigid standards in the manufacture of ice boxes in order to compete with electric and gas refrigerators, on the one hand, and to popularize the use of ice the year round, on the other. The zinc industry has undertaken standardization in order to compete with other types of metal roofing and with other methods of rust-proofing of iron and steel; the brick industry in order to compete with other types of building materials; the radio to compete with the phonograph; cotton and woolen textiles to compete with silk and rayon, etc.

Interchangeable Parts and Repairs

While interchangeable parts have aided in the extension of the market, because of the ease with which repairs and service on machinery or equipment can be made, this sometimes means partial or total loss to the individual producer manufacturing parts. So important a feature is this in certain manufacturing industries that it has been the source of one of the principal objections to further industrial standardization, as, for instance, in the recent attempt to standardize the threads on transits and tripods. Probably fifty per cent of the automobile parts are supplied by separate manufacturers. The German manufacturers of typewriters have begun to manufacture spools to fit American-made typewriters sold abroad. The English manufacturers of Darwin and other razor blades are making blades to fit all types of American-made safety razors.

Even this aspect of standardization, however, has its advantages. A Swedish boat company is building boats equipped with engines which can be repaired with Ford parts. More and more parts of the modern, mass-produced American automobile are being manufactured by highly specialized plants, because it is more economical. It is cheaper to have the body built by Fisher, the roller bearings by Hyatt, the tires by rubber companies, etc., than for the same plant to try to produce all parts. A manufacturer of gear machinery found that it was more economical for him to purchase the special gears he used in his gear-making machinery than to produce them himself. The other firm specialized in the mass-production of gears, and thus gained an advantage even

over a firm producing gear-making machinery. It is generally advantageous to the consumer, either manufacturing or ultimate, to have supply firms in competition with the original manufacturer, since monopoly of repair replacement parts, particularly when backed by patented rights, may, and frequently does, result in high prices.

Standardization and Second-Hand Business

Regardless of where parts are produced, or who manufactures them, servicing in certain industries practically necessitates standard and interchangeable parts. Such industries are the telephone and telegraph, electric light and power, the automobile and even the radio industries. With the assurance of the ability to secure repair parts arises the possibility of increasing the range and scope of the second-hand business. As long as standard parts can be had inexpensively, second-hand cars will be bought by many people. With the assurance of a second-hand market, and consequently of the standardization of second-hand values, definite "trade-in" prices can be fixed. Thus, by offering an inducement to people to buy new cars and to trade in the old ones, the turnover is increased for both second-hand and new equipment. This policy can be distinguished from price-fixing of the usual sort only so long as it is based upon fairly rigid quality standards.

Reduction in Advertising, Selling and Distribution Costs

Certain other advantages directly related to marketing conditions are claimed for standardization. Among these are reduction in advertising and salesmanship costs. Unfortunately, there are few data to support any such contention, although there are equally few to support the opposite contention. A rubber firm found that standardization of samples saved $5,000 a year.[1] In several cases, the elimination of numerous varieties has been found to increase decidedly the efficiency of the sales force, making possible a per-unit reduction in this type of overhead. The Division of Simplified Practice maintains that standardization will eliminate

[1] W. D. Pardoe, "Simplification in Industry," *Factory*, May 15, 1921, pp. 1175–1177.

spurious claims in advertising and excessive expenditure to get across unessential selling points, and will fix attention upon essentials.

Standardization of the product has led to the development of standard crates, boxes, containers and methods of shipping. Several considerations are involved here—original cost, ability to withstand abuse in transit, re-use, convenience in handling in shipment and in the warehouses of the producer and consumer, convenience in final distribution, etc. The Bureau of Agricultural Economics has given this subject much attention and has developed standard containers for packing, shipping and storing of apples, potatoes, eggs, oranges, grapes, etc. In several of the large manufacturing concerns, such as the Western Electric Company and the General Electric Company, packing for shipment has become a fine art. The General Electric Company has developed standard packing boxes for shipping practically all of its equipment. Different types of containers are used according to the type of carrier, the length of travel, climatic conditions to which the equipment is subject in the course of transit, etc. While unable to state savings in definite monetary terms, these companies feel that this type of standardization has resulted in considerable savings.

Somewhat more remotely connected with the standardization of the product, but of peculiar significance to the farmer, is the advantage standard products have as collateral, in the form of graded warehouse receipts, as a basis for securing loans.[1] Loans extended to farmers under the Federal Land Bank and Intermediate Credit Bank systems and, more recently, under the Federal Reserve Bank System, can be secured by warehouse receipts covering produce of known standard quality.

Savings to Wholesalers and Retailers

In a sense, the foregoing discussion has been largely confined to a consideration of the avenues of savings through standardization for the manufacturer. Every manufacturer, however, is in some respect or other an intermediate consu-

[1] "Agricultural Standardization on the Pacific Coast," *op. cit.*, pp. 107–114.

mer, whether of raw materials subject to quality specifications, semi-finished or finished materials, machinery or other equipment used in the process of operation, repair parts, etc. Much less consideration, however, has been given to the effects of standardization upon the wholesale and retail businesses. One reason for this is that the wholesaler and the retailer deal, for the most part, in goods to be sold to the ultimate consumer, and there has been much less deliberate, conscious standardization of ultimate consumers' goods than of the producers' or intermediate consumers' goods. With the exception of the automobile, certain electrical goods, shoes, etc., such standardization as there is has come by way of haphazard force of custom. There is, consequently, very little opportunity to compare standardized with unstandardized lines in such a manner as to bring out clearly the effect of standards upon wholesale and retail costs.

However, certain possibilities of savings to these business groups through product standardization stand out quite clearly. The experiences of the Regal Shoe Company and the Knox Hat Company as distributors, for example, show that the reduction of the number of sizes in stock and the selection of those sizes for which the demand is the greatest have resulted in decided savings. More rapid turnover of stocks has meant a more rapid turnover of capital tied up in stocks, and consequently a much smaller investment in stocks is required to do the same volume of business. Standard sizes have facilitated the process of fitting, and consequently cut down on clerical help. The elimination of slow-moving stocks has considerably reduced the amount of space required in the store and has cut down on rentals.

The lower cost, in these cases, has enabled the store to set lower prices, and thus to widen the market. A further effect, it seems, has been to increase the confidence of buyers in the quality of the product, so that customers once secured can be relied upon to a greater extent than before to return for further supplies. It seems to be true, also, that a standard stock enables storekeepers to borrow on better terms because of the practical certainty of a satisfactory disposal of the stock in case of default on loans.

The growth of package-goods industries, especially in the

grocery stores supply field, seems to bring about a degree of more or less unconscious standardization, the possibilities of which are apparently being realized in some quarters at the present time. Package goods, of course, enable the retail store to handle a much larger volume of trade with less space, less tied up capital, and less clerical assistance. The Drug Manufacturers' Association has recently undertaken a survey with the object in mind of cutting down the enormous duplication of these package goods in drug stores which prevents them from fully realizing the economies made possible by the growth of standard package goods.

Certain of the large department stores and mail-order houses, notably Montgomery Ward & Co. and numerous members of the National Retail Dry Goods Association, are turning their attention to the matter of establishing minimum standards for goods sold over the counters of branches and member stores. It is believed that this is a worthwhile investment in public good-will and, at the same time, a method of cutting certain costs attendant upon excessive multiplication of sizes, varieties and qualities under numerous brand names.

The Cost of Standardization

Against this rather incomplete catalog of savings, achieved or achievable by the business man because of standardization, should be set down the costs of putting the standardization projects into actual practice. The main difficulty with this procedure is that the debit column is no easier to compute, or even to estimate, than the credit column. In fact, the almost total lack of figures of any description makes extremely hazardous even generalization concerning the nature of these costs.

Adequate figures for industry as a whole would have to show the total amounts and the incidence of the following expenditures:

(1) Scientific and technical research leading directly to the devising of standards for industrial usage. This would include the work of scientific laboratories privately or publicly owned, the research conducted by the various technical and engineering societies, and

the supporting research performed at various places under the auspices and at the expense of trade associations.

(2) The promotional work of such organizations as the Commercial Standards Group of the Federal Department of Standards, the Department of Agriculture, trade associations, and such "single-purpose" standards clearing houses as the American Standards Association.

(3) The maintenance of standards departments by private companies, states, Federal Government and other governmental bodies. Expenses incident to the establishment, maintenance and operation of such departments would have to be separated from other expenses. Where standardization work is being carried on within separate departments, some method of computing the amount of time and materials chargeable to the standards work would have to be devised.

(4) The scrapping of machinery, materials and personnel involved in the reorganization of plant and equipment in the introduction of standardized purchasing methods, processing methods and standardization of product.

The annual expenses of the American Standards Association, of course, are available. But the expense account of the Association represents by no means the total cost of establishing American Standards through its procedure. The expense of carrying through the work of the sectional committee and the standards council, and the time and traveling expenses of members and representatives of cooperating groups is borne not by the Standards Association but by the various groups. How heavy this expense may be is shown by the membership and character of the work of a sectional committee on specifications for cast iron pipe:

> "The sectional committee on specifications for cast iron pipe of all types except soil pipe, comprises 96 individuals representing 9 technical societies, the Federal Government, substantially all important pipe makers, many independent experts, and representatives of large consumers. Fifteen sub-committees cover all details of specifications. An elaborate questionnaire is now being circulated to the end of

collecting the expert knowledge of principal users of cast iron pipe throughout the industry, so as to supplement an extensive research which is based on an expenditure of about $50,000 subscribed by the pipe manufacturers."[1]

The Department of Commerce conducted a survey of expenditure on standardization by technical societies, trade associations, state and federal governments, the summary of the results of which is reproduced in Appendix K of this study. The toal of $8,207,256.10 reported by all groups for 1926 can not of course be taken as an accurate figure based on data. The absence of any very clear idea regarding the expenditure for standardization on the part of many of these reported societies may well invite skepticism as to the accuracy of expenditure estimates.

The question, "What has the (standardization) movement cost the petroleum industry?" has been answered as follows:

"Thousands of dollars invested by the American Petroleum Institute in the organization and carrying on of its division of standardization, in time of its members and officers, in conveyance and maintenance charges. Thousands of dollars invested by the producing companies for the same purposes as applied to committee members and others interested in the movement. Thousands of dollars invested by the manufacturers of rig irons along the same lines for preliminary work in committee, and for drawings and blue-prints, correspondence and telegrams and various items too numerous to mention but none the less expensive.

"And last, but not least, the change from the many styles, sizes and dimensions of rig irons to the styles, sizes and dimensions agreed upon and sanctioned by the institute. This burden, if it can be so-called, although willingly undertaken, is probably the heaviest to be borne. The company, of which the author of this article is vice-president and general manager, has alone invested $100,000 in accomplishing the change. This includes engineering work, patterns, machine tools, and equipment, experimental work, catalog compilation and advertising to the trade. Eleven companies are licensed to manufacture American Institute irons and it is reasonable to believe that the cost to all manufacturers to make the change, when all have finally changed in accord with the movement, will be well over the million-dollar mark."[2]

A news release of the National Industrial Conference Board reports that about $200,000,000 were being spent

[1] *Sustaining Members Bulletin*, *op. cit.*, April 26, 1928.

[2] "Inception, Progress and Consummation of Standardization of Rig Irons," *op. cit.*, p. 147.

annually in the United States for industrial research by industrial corporations and the Federal Government. "In addition seventy trade associations are spending about $15,000,000 a year in research, and 152 colleges and technical schools about $1,500,000."[1] Probably a considerable proportion of this research is, in some fashion or other, directly chargeable to standardization.

But even in the face of what may seem at first glance very large costs, those business executives who have tried standardization in their own plants appear to be finding the change well worth while. A large electric light and power company, one of the leaders among the public utility companies in industrial standardization, will not undertake a standardization project unless it will pay for itself in the first year. The fact that this company does do a very large amount of standardization on this basis indicates the great extent of the economies of standardization. In another case, in the rubber industry, the introduction of a single standard saves the cost of maintaining a laboratory research technical force of thirty for a year. In many cases the savings, while in themselves not accurately computable, are considered to be so great that the cost of bringing about the change to the standard is thought scarcely worth computing.

Summary of Possible Savings

To the skeptical reader, the foregoing discussion may furnish considerable cause for doubt. There is scarcely a single estimate or generalization possible concerning savings due to standardization which is not open to attack in some particular, from some quarter or other. It would be a laborious task, in itself, to tabulate the variable factors that might account for at least parts of the various estimated savings, or that might entirely vitiate such estimates and generalizations. Yet, as has been pointed out in considerable detail, this is not the whole story. A summary of the findings may serve to sharpen the picture of the relevant facts:

(1) The general estimates of savings due to standardization, mostly made in the first instance for publicity

[1] National Industrial Conference Board, News Release, Nov. 14, 1927.

purposes, are useful principally in that they represent forecasts or summaries of shrewd observers. They do not purport to be exact statements of fact. Their principal weaknesses are:

(a) They are loose and unsupported, for the most part, by detail.

(b) They do not indicate the incidence of the saving. Those who gain may be the general public, the manufacturer, the wholesaler, the retailer, or the wage earners. Saving to one may not be saving to all.

(2) Comparatively few data can be directly traced to the books of particular companies. Lack of standard cost accounting systems and different methods of figuring and of allocating costs and savings require caution in interpreting even these figures. But what data we have force the conclusion that standardization, intelligently carried out, has paid, and paid well.

(3) On a cost accounting basis, savings due to purchase upon specifications and savings due to reduction of stocks and inventories through standardization are those most easily chalked up on the credit side of standardization. A high degree of standard processing, as contrasted to a less standard processing—for there is no such thing, under machine industry, as completely non-standard processing—serves mainly to facilitate efficient mass production. For the most part the economy of standardization of manufacturing processes can not be separated from the complex factors that make up the "economies of mass production."

(4) Since a modern industrial plant is in itself a "machine," smooth, economical and continuous operation necessitates a high degree of standardization in every important phase of its operation. In this larger sense, no "saving," whether due to standardization of any sort or any other technical or managerial innovation, can be separated from the concert of conditions necessary to the smooth operation of the entire industrial unit.

(5) Evidence points to the definite conclusion that retail-

ers, wholesalers, consumers in general, farmers and labor can and have benefited from standardization. Gains are not restricted to manufacturers.

(6) The costs of formulating and promulgating standards, and adopting them into production routine, are, in many cases, large. Compared to the savings standardization has directly or indirectly effected, however, these costs are very definitely of minor importance.

(7) Without standardization carried out on a far-reaching and fundamental basis, some specialized industries would not exist at all. The more complex industrial processes become, the more highly mechanized each phase and aspect of industrial production and distribution, the more industrial interdependence demands a smooth intermembering of parts, operations and processes. That is to say, the growth of industry requires increasing standardization as an elementary basis for existence.

(8) The character of the savings summarized in this chapter indicates that formal, deliberate, cooperatively-established standardization programs have only begun to "scratch the surface." Many materials, equipment, processes and finished goods have been untouched by this type of standardization. In the light of what we know about standardization in the past, fragmentary as it may be, the extension of this technique into these hitherto unstandardized industries offers almost unlimited possibilities for increasing the efficiency of industry for the benefit of all parties concerned.

CHAPTER XII

STANDARDIZATION AND MARKETING TECHNIQUE

THE familiar facts of the present market situation are (1) enormous quantities of cheap commodities and (2) a "limited" market. The major business problem has shifted from ways and means of increasing production to ways of marketing the ever-increasing quantities of goods being turned out on a mass-production basis.

More discussion of the "buyers' market"; statistics showing the steadily rising costs of distribution; discussions of the uses and abuses of the latest business giant—specialized advertising—and the rise of theories discussing the "inability" of consumers to buy the total output of commodities because of the existence of differential income groups or habits of spending and saving, are indications of the widespread interest this shift in the economic posture of affairs is arousing. That the situation has in many respects become acute seems to be generally recognized. The proposed remedies range from excess profits and corporation taxes to ways and means of reapportioning income, from formal price control to "high pressure salesmanship."

Mass Production and Distribution

Standardization touches this problem on both major fronts. On the production side it may be used to lower costs to the minimum, making possible the realization of every economy of mass production. Again,[1] it may be used as an aid in the further regularization of production processes, thus providing, perhaps, a partial relief from the periodic "glut" of goods on the market caused by recurrent business fluctuations. It may also come, in the course of time, to play a very important rôle in the literature, the character of the appeals, the emphasis and the tactics of advertising and selling.

[1] See Chap. XIV of this volume.

It should be pointed out that standardization, to the extent that it has already been applied in production processes and to the end product, may be held indirectly to have affected this market situation in several respects. In the first place, it has resulted in mass production. Mass-produced goods are, as a rule, the most cheaply produced goods. At the same time, these goods must be sold on the widest possible market. Generally with all commodities for which the demand is elastic—and a larger and larger percentage of the total productive output is probably falling into that class—the cheaper the goods the wider the market. And the wider the market the cheaper the goods can be manufactured, provided production has not reached the point of increasing costs.

In other words, the wider the market the more highly standardized can processes and commodities become, up to the point of decreasing returns. But the extent of the market is no longer a matter of geographical area but of aggregate buying power. Aggregate buying or (assuming production) consumers' purchasing power is a function of three variables: the distribution of income, the purchasing power of the dollar and the habits of spending and saving of the mass of income receivers.

The current market situation has brought these facts into clear focus and has given rise, on the one hand, to a theory of the economy of high wages and, on the other, to the phenomenon of a plethora of buying. Some have argued that the habits of saving are disappearing from the lexicon of economic virtues for ever-increasing portions of the total population. At any rate, cheap goods in large quantities within general relatively high ratios of serviceability offer every inducement to the average income receiver to part with his money. And high wage ratios, to the extent that they exist, have increased the capacity to pay.

Devices Employed by Advertisers and Salesmen to Widen the Market

Increasing quantities of mass-produced commodities and increasing real per capita purchasing power have provided the economic justification for the existence of advertisers

and salesmen. These groups have in no way failed to take advantage of their opportunity, with the result that the advertising and selling bill represents no small part of the rising cost of distribution and marketing of the goods produced. There is reason for believing that that particular cost is rising relatively to the other costs of marketing in a very significant fashion.

A considerable part of the total volume of advertising, particularly in the field of producers' goods, has been informative. A considerable part, in certain restricted fields of both producers' and consumers' goods, has been pure "good will" advertising. There has been a tendency in more recent times for a considerable part of the total advertising expenditure, particularly in the field of end consumption goods, to be directed towards what has been characterized in criticism as "high pressure" salesmanship. This type of advertising, characterized by the attempt to push sales by the popularization of trade names, manufacturers' slogans and numerous types of personal and social appeals—in all of which there may be a considerable misrepresentation of fact or emphasis upon unimportant or irrelevant features of the commodities represented—is coming to occupy a position of great importance in the advertising field.

There is no attempt here to deprecate this change in advertising and selling policy, as such. It has, in many respects, been highly successful, both in the field of quackery and in the sale of "legitimate" goods. It has popularized and made possible the mass production of many goods and services whose value will scarcely be questioned in any quarter. But the question to be resolved here is not whether advertising has been abused as a technique and has succeeded in advancing spurious claims, but whether or not it has reached, in some industries at least, the stage of diminishing returns and, if so, how standardization has changed or may be used to change the tide.

In face of the almost total lack of reliable statistics, no definite answer to this question is possible at the present time. There are probably some industries in which highly competitive advertising has never been particularly success-

ful. In others, as is definitely known, it has been highly successful. There seem, however, to be certain limits beyond which advertising techniques can not be pushed without doing definite harm to both individual producers and industry in general. From a business man's point of view, the real advertising problem consists of employing the correct sales technique as far as it pays and no further. At any rate, there seems to be a growing conviction on the part of a great many industrial leaders that the present advertising tactics are being carried, in some respects, to such lengths that advertising is becoming a liability rather than an asset.

Even here, however, a word of caution is necessary. There can be no questioning, in any industry, of the brilliant success that advertising has scored for particular, individual products. Advertising and salesmanship, of whatever type, may accomplish several different things: (1) it may aid in the expansion of the total market frontier; (2) it may aid in the expansion of the market for a particular industry at the expense of another industry; (3) it may advance the total sales of a particular producer at the expense of other producers in the same industry; or (4) it may advance the producer of low-quality goods at the expense of the legitimate manufacturer. If it accomplishes the first result, whether by increasing the general disposition to purchase or by guiding new expenditures along certain channels, it is from a general business point of view desirable. If it accomplishes the second, what one industry gains another loses. If it accomplishes the third, the gain of a particular producer is equal to the loss of all competing firms, subject, however, to the proviso that the firms eliminated may possibly be inefficient firms, which is not always and of necessity the case. If it accomplishes the fourth end, the ultimate result may be, and in many cases probably will be, to bring an entire industry into disrepute. In the latter case, the result indicated is subject solely to the particular firm or industry being "found out" and being subject to punitive action, either at law or by loss of trade.

It is the fear that too much advertising has achieved this fourth result that seems to be the basis for the general business complaint against certain types of advertising and

market tactics. It is the fear that advertising is aiding in the elimination of the small firm, is not permitting survival upon the basis of real quality or price competition, that seems to be back of the rising interest in association advertising, particularly where the trade association represents the smaller producers in an industry dominated by one or more gigantic producing or distributing companies. It is the fear of losing a market to a competing type of commodity, or the desire to widen the market by supplanting one type of commodity by another, that seems to be the motivating force in general trade association interest in a successful sales technique for the entire industry. It is in the general hope of sharing in the gradually-widening market made possible by the increased consumer purchasing power that gives all producers an active interest in a certain minimum, at least, of "fair play."

With respect to these four different results that may flow from persistent advertising and sales effort, the following claims are advanced for standardization:

(1) Standardization cheapens productive processes, increases the per capita output and the per capita purchasing power and offers an equal opportunity to all to get a share in the increased business.

(2) Standardization affords a basis upon which commodity price competition is possible, and a basis upon which to make a definite, intelligible and sustained appeal for trade.

(3) Standardization makes possible purchase upon specification rather than upon brand or trade name, thus cutting the costs of the individual producer by avoiding the extra payment upon hypothecated "good will" born of successful or anticipated trade-mark or brand monopoly; and deflates the notion, in the mind of the consumer, that brand or trade names count except as they accurately reflect both price and assured and maintained quality of the advertised article.

(4) Standardization provides: (a) a definite understandable basis upon which to turn trade from the manufacturer of low-quality goods to the manufacturer of goods of real value; (b) a basis upon which the individual manufacturer, group of manufacturers, trade association, technical society or trade publication can maintain its position in the trade by

discriminating against the "outlaw"; and (c) a basis upon which legal action can be taken against unscrupulous manufacturers.

In all four cases, standardization will facilitate the elimination of spurious and irrelevant claims and stress the substitution of informative matter. Where advertising is conducted by the trade association, standardization will aid the elimination of duplication of advertising for the same commodity by many firms in the same industry. From the consumer's point of view—either ultimate or intermediate—the use of standards in advertising copy seems to afford, for the first time, a real basis of comparison as to values, where quality and price and not appearance and style are the dominating factors.

Certification to the Buyer

The use of standards in advertising, and in marketing in general, may take the form either of indicating that the advertised or displayed goods are manufactured in accordance with certain definite, generally known and widely approved standards, such as those of the American Standards Association or the Federal Specifications Board; or of stating in the advertising copy or the sales talk the relevant constituent materials, method of construction, etc., pertaining to the product, and what or whose standards, if any, are met. In either case the manufacturer or seller is certifying to the buyer that the qualities or the properties meet some definite and recognizable specification.

Originally, and to a large extent at the present time, this was the idea that lay back of trade names and brand monopolies. The brand name or slogan was taken by the purchaser as a guarantee, an *ipso facto* certification, of certain definite, determinable and desirable qualities possessed by the goods bought. Where the manufacturer produces a wide range of products under a single brand or trade name, or where the specific properties of the product are of vital importance to the buyer, the trade or brand name can at the most attest only to the honesty of the manufacturer in promising to give value received.

That is to say, trade and brand names, in and of them-

selves, are subject to abuse and to the charge of inadequacy, or both.[1] And it is to meet this situation that both producers and consumers are becoming interested in standards and specifications. In some cases, as already pointed out, the company may merely advertise to its buying public that it has tested goods offered for sale and that those goods have been discovered to meet certain well-known requirements (generally unstated) and are properly represented in the advertising and selling media. Macy's Department Store in New York City and Montgomery Ward and Company, mail order house, use this type of advertising to a limited extent.

Much more definite and usable is that type of advertising that specifically states on the label the properties or component parts of the commodity sold. This may range from the rather indefinite statement that goods are manufactured, for example, in accordance with such a law as the Pure Foods and Drugs Act, to the definite statement of "contents," in which is set forth an itemized and scientific list somewhat similar to that to be found in a specification of properties.

But the attempt to enumerate all the relevant characteristics of many, if not most, commodities, would require a great deal of space, a considerable body of information unintelligible to the average buyer, and the reiteration of much matter of common knowledge. A short-cut method of achieving the desired end and of eliminating these objectionable features is the publishing of a statement certifying that the commodity has been produced in accordance with standards set up by a trade association or technical society, the American Standards Association, the Federal Specifications Board or other body.

The Soap and Glycerine Producers' Association, the American Petroleum Institute, the American Gas Association and the Underwriters Laboratories of the National Board of Fire Underwriters are conspicuous examples of associations permitting the use of an association stamp upon goods sold by the membership or by manufacturers meeting standards set by the association.

[1] It is not intended to imply here that trade and brand names are always or even usually of this sort, but simply that they may be, and have been in many cases, so used.

Several of the national standards bodies permit the use of their stamp, monogram or initials upon goods manufactured according to their specifications. Very wide use has been made of this type of certification in Germany. The DIN stamp is registered by the Deutscher Normenausschuss and, as was explained before, can only be used by and with its express permission. Failure to comply with the specifications is cause for withdrawal of the right to use the symbol in advertising, and abuse in the use of the symbol gives the Normenausschuss the right to prosecute.

Several engineering societies, both here and abroad, have permitted the use of their symbols in advertising goods manufactured according to their standards. Examples in the United States are the American Institute of Electrical Engineers, the American Society of Mechanical Engineers and the Society of Automotive Engineers. In Europe the abuse of the symbol of an engineering standard has, on occasion, aroused the society to the use of advertising media calling attention to the abuse and warning buyers against purchasing goods from the manufacturer or manufacturers in question.[1]

Several periodicals and technical journals make attempts to protect buyers from sub-standard goods by refusing to accept the advertising of any firm whose products do not meet the standards approved by the society publishing the journal. Such is the case with the Journal of the Society of Automotive Engineers and the Journal of the American Institute of Electrical Engineers. Other examples are to be found in the case of Good Housekeeping, the New York Herald Tribune, Modern Priscilla and the Rural New Yorker.

[1] One example of this sort that has come to hand is worth reproducing:

V
D E

Approval Office of the Society of German Electrical Engineers.
Berlin W 57, Kurfürstenstrasse 15/16.

Notice:

We have found that the firm of Christian Dress Hannover-Vinnhorst, has manufactured D-Fuses for current strengths above 7 amperes, 500 volts, marked with the V D E symbol. They, however, have the authority for the use of the approval symbol only for 6 ampere fuses of a certain construction. Warning is therefore given against the purchase of any safety fuses of this firm marked with the V D E symbol and intended for higher current strengths than 6 amperes.

In these latter cases it is not always clear just what protection is offered the purchaser, although the official announcements of these publications represent that they do not accept fraudulent or misleading advertising. These terms are not clearly defined.

Other attempts along this same line have resulted in municipal, state and federal legislation. Federal, state and municipal laws providing for inspection of foods and drugs are typical examples of attempts to eliminate sub-standard products. In some cases, such as the Pure Foods and Drugs Act, the proposed Truth-in-Fabrics Bill and the Lodge Misbranding Bill, this matter has been handled by the regulation of labeling and branding. The National Better Business Bureau has, as a result of an agreement with the Federal Trade Commission, sponsored a movement for the adoption of "a policy of correctly describing furniture woods in accordance with rules laid down and subscribed to by the industry."[1] Over 90 per cent of the furniture manufacturers have agreed to accept these rules as their guide in advertising, cataloguing, etc.

The Federal Certification Plan

Perhaps the most interesting of these numerous certification programs is that which has been inaugurated under the auspices of the Bureau of Standards and officially designated the "Certification Plan." The essence of this plan consists of the compilation and the circulation to interested parties of "lists of manufacturers who have expressed their desire to supply material in accordance with certain selected specifications and willingness to certify to the purchaser upon request that the material thus supplied is guaranteed to comply with the requirements and tests of the specifications."[2]

[1] An example of the use of American Standards in advertising is to be found in the *Official Bulletin, Heating and Piping Contractors National Association*, July, 1928, p. 146, which reads (in part) as follows: "Standards for Malleable Iron Screwed Fittings, Cast Iron Flanges and Flanged Fittings, have been established under the procedure of the American Engineering Standards Committee. . . . If you wish copies write for information to the Heating and Piping Contractors National Association."

[2] Bureau of Standards, "Facilitating the Use of Specifications," circular, 1928.

At the present time, 146 "Willing-to-Certify" lists have been compiled by the Bureau. In having his company's name placed on the lists, the manufacturer expresses his willingness to certify, if and when requested to do so, that the goods supplied are manufactured in accordance with the designated United States Government Master Specification. Until this request is entered, no guarantee of compliance with the Master Specification can be said to exist.

Manufacturers are to be permitted to advertise the fact that their names have been entered on the "Willing-to-Certify" list. However, the Bureau incurs no obligation under the plan to remove from the list the names of manufacturers who fail to comply with the conditions of the Master Specification. It is expected that trade associations and the pressure of "honest" manufacturers will bring the recalcitrants to terms. The Bureau does not propose to check, either at the time a manufacturer's name is placed on the list or at any time thereafter, to discover whether or not he is actually producing to standard. It is conceivable that "Willing-to-Certify" might be taken by buyers as a statement of actual compliance, and that sub-standard goods might continue to be bought from a manufacturer so advertising his goods, even though his failure to comply might become known. It is expected by the promoters of the plan that this situation will not occur. That it might occur, however, is recognized by the Bureau. In order, therefore, to provide purchasers of materials with access to facilities for carrying on tests suitable to determining compliance with federal or other specifications, the Bureau has prepared a list of College and Research Laboratories to which buyers may have recourse in case the manufacturer is suspected of misrepresentation.

Somewhat the same conditions surround the certification of commodities as having been "Made in accordance with Simplified Practice Recommendation No.—," as is possible under the procedure of the Division of Simplified Practice.[1]

[1] "Primer of Simplified Practice," *op. cit.*, pp. 38–40. It continues; "The Department of Commerce does not grant any authority, nor does the label imply any sanction of the department as to the particular product in connection with which it is used. . . . The department does not supervise or control the use of the label, nor is any individual or association authorized to act as its agent for the purpose of seeing that the label is properly or truthfully used."

An attempt to give the Federal Specifications used in the Certification Plan wider publicity and the weight of greater authority has come out of negotiations for the elimination of a certain amount of functional over-lapping in the work of the American Standards Association and the Bureau of Standards. An arrangement has been perfected under which the Bureau of Standards will from time to time submit its Master Specifications to the procedure of the American Standards Association for approval as American Standards.

Cooperative Advertising and Selling

Cooperative advertising and selling is generally of two sorts: that which advertises the products of another firm or industry while advertising one's own product; and that which involves the uniting of the advertising effort of several independent producers through the medium of a trade association or by independent action. The first type is that in which an advertiser points out the advantage of using his own product by a citation of cases in which his product is used to the advantage of another type of producer. In turn, it is expected that the other manufacturer will play up that feature of his production processes to the advantage of the first.[1]

Many examples of the second type of cooperation abound, ranging from the generalized popular "Say It with Flowers" and "Save the Surface" (paint and varnish manufacturers) campaigns and the attempts to create a national "Apple Week," "Mother's Day," "Postcard Week," etc., to the more specific and concrete statement of commodity competitive facts in such campaigns as those carried on by the zinc industry, the brick and cement industries, etc. While in both cases it is the commodity, not the brand or trade name, that is being pushed, standards are relevant in any definitive sense only to the latter.

The zinc industry is attempting, by the establishment of standards and their popularization through advertising media,

[1] E. G. Timken and Hyatt roller bearings, Fisher bodies, Stromberg carburetors, Champion spark plugs, etc., and General Motors cars; soap advertising, showing how use of products keeps cereal plant clean, etc.

to win back the metal roofing market, largely lost to tin and copper sheeting producers. The zinc coating industry has lost heavily through the decline in popularity of galvanized iron, partly due to the entire lack of quality standards among certain producers in the industry in the past. The cement and brick industries are both trying to advance their respective products in the building trades and road construction markets by the establishment of standards and by wide circulation of this fact among present and prospective users. The Portland Cement Association has been particularly successful in this respect. At the present time there is a concerted movement among the ice manufacturers to forestall the invasion of electric and gas refrigerators by establishing rigid construction standards designed to reduce ice meltage to the minimum and to expand total storage area and cubic space to the maximum for the box price.

Whether manufacturers are organized as a trade association to push the sale of a particular line of product, or as a local merchants' and manufacturers' association to push the sale of locally manufactured products, the costs of the advertising must be met out of a common fund. It would seem that this process of pooling advertising expenses and the attempt to popularize the fact that the goods advertised are manufactured in accordance with definite and widely recognized standards should aid in reducing the total money volume of advertising. In the first place, a large percentage of advertising seems to be directed solely towards diverting business from one manufacturer and giving it to another. A manufacturer must, under the present scheme, advertise to hold his market as well as to extend his sales. This bidding up of advertising costs by competition within the industry would seem to be almost entirely eliminated in association advertising of goods or equipment for which the demand is inelastic. Where the demand is relatively elastic, it would seem that a concerted, "single-purpose" drive of the entire industry, such as that conducted by the zinc, cement, glycerine and ice refrigerator industries, would not only be enormously more effective, on the whole, than the uncoordinated advertising drives of the several producers, but would eliminate the duplications, the working at cross purposes

and, generally speaking, would cut down the advertising overhead for the industry as a whole.

Despite the soundness of this line of reasoning, there is little or no evidence either to support or refute the contention that the use of standards in advertising reduces the total advertising costs.[1] This fact may in part be due to the late date at which standards have been introduced into advertising media, and in part to the relatively small extent of the total advertising surface in which they have been used. But a still more obvious reason seems to lie in the fact that the type of standardization that has most directly and most widely touched the advertising field has been simplification. And here advertising had been used, for a large part, in the process of bringing simplification about. As has been pointed out: ". . . advertising is now being used to make all customers want . . ." the simplified line, and the "things which can be made with the most efficient production processes."[2]

Summary

If it can not be established definitively at this time that the use of standards in advertising has reduced the advertising cost per dollar of product, the practice can be held to have affected the market to the advantage of the business community in several ways. First among these is the building up of a reputation for the product by the guarantee of quality that the standard assures the consumer. In the second place, if it can be held to aid in the elimination of the maker or distributor of low-quality goods, it seems reasonable to grant the contention that in fixing attention upon the purchase and sale of good-value materials and equipment it increases the real purchasing power of the buying public, making possible a larger market.

To the extent that standards are necessary in the produce exchanges as a basis for classification and quotations, standards cheapen the cost of distribution by aiding the estab-

[1] See, for example, Hugh Elmer Agnew, "Can Standardization Reduce Advertising Costs?", *Annals*, *op. cit.*, May, 1928, pp. 253–258.

[2] Julius H. Barnes, "Standardization as a Creator of New Advertising," *Printers' Ink Monthly*, January, 1928, pp. 23, 24, 100, 103.

lishment of national and international goods markets. This third market advantage of standards is sometimes overlooked, yet its significance is great. Without standards, quotations on wheat, corn, graded cattle, hides and carcasses, cocoa, cotton, silk, rubber, metals and numerous other commodities would be impossible. An extension of this same principle into other fields is to be recognized in the practice of standardizing both repair service and trade-in value of automobiles and in the proposal of the radio division of the National Electric Manufacturers' Association to fix standards for trade-in values of radio sets, although in the latter case the purpose may be price-fixing rather than the establishment of technical standards. It is expected that the effect of such standardization will aid the market for both new and second-hand equipment.

CHAPTER XIII

STANDARDIZATION AND SIZE OF BUSINESS

NO ISSUE in standardization literature has been the subject of more loose speculation than the problem of the effect standardization will have upon the size of the business unit and the scale of business operations. The problem is quite separate from the question whether or not a business can employ standardization techniques to advantage regardless of size. It is also quite separate from the question of the general advantages of large-scale business.

There is one sense in which the present statement of the question precludes an answer, for a great deal depends upon the character of the industry in question. In the case of natural monopolies, for instance, standardization can be held to be responsible, in part, not so much for the elimination of the small plant as for the building up of the large plant by cheapening the processes of producing goods and services, and thus widening the range of business through an increase in the number of customers in the local area. Most public utilities and much of local industry serving the needs of a comparatively small community fall into this class.

To the extent that natural monopolies come into the picture, no quantitative study could answer definitively the question of the effects of standardization upon the competitive advantages of the small and the large plant. Indeed, without quantitative data, which are not at present available in any form, it is impossible to give any specific answer to the question for other industries. But in the absence of such data, it is possible to set down the nature of the conditions under which standardization can be expected to aid or retard the small or the large-scale business. It is convenient to discuss the problem under two headings:

(1) The effect of standardization upon the competitive advantages of the small and the large plant.

(2) The effect of standardization upon the trend towards mergers, consolidations and cartels and the possible elimination of the small plant.

The Small versus the Large Plant

At the outset it is probably safe to say that one type of industry—domestic and native arts—will always be carried out on a small scale, at least in the production stage. It may be true that machine industry is gradually narrowing the range of handicraft arts, but what is left—and it seems sensible to believe that there always will be something left—is inherently capable of being carried out on a small scale only.

Even where machine methods are used, if the bulk of the business is conducted on a specialty basis, small-scale production is most feasible. As long as a large special-order business exists, the small plant will be able to survive, for the reason that, in the main, such business does not call for elaborate equipment. Consequently, the cost of such a business must be largely confined to expenses that vary more or less directly with output. It is true that in some cases a special-order service is conducted as a sideline by a large plant—frequently at less than cost—in order to secure the patronage of customers who also buy considerable quantities of the standard and more cheaply produced commodities. But even here there is a tendency for the large producer to eliminate the special-order line and permit the small producer to take over such business on a "custom-made" basis.

But wherever standardization is applied, wherever machine operations are systematized and permitted to run continuously, the result is mass production and standardized output. The full advantage of machine production can be had only by operating to capacity, or as near to capacity as safety and the danger of breakdowns permit. Wherever the demand for a given commodity is large, it will pay to install expensive machinery, for continuous operation brings the cost per unit of output down to the point where it is cheaper to produce the commodity or equipment in that way than in any other. But where the demand is not large, it will pay to buy the desired materials rather than to make them sepa-

rately. Decision must rest upon the relation of the following variables: (a) prices quoted plus the cost of transportation and handling incident to purchase outside the plant; and (b) the cost per unit of output (all costs, overhead and variable, included) of operating a machine within the plant at less than capacity.[1] Where these two costs balance and quality is the same, it will be merely a matter of choice as to the course to be pursued with reference to the materials in question. Where the volume of demand for this equipment within the plant increases beyond this point, it will pay to install the machinery.

On the other hand, if the total demand in many industries, large or small, for any particular part, fixture or type of equipment makes possible manufacture at some one point on a mass-production basis, the specialized plant is bound to appear. These plants, although producing on a mass-production basis, may be and frequently are comparatively small business units. Such a situation obtains in the automobile industry where, until recently at least, many of the parts and fixtures have not been used in the individual plants on a scale sufficiently large to warrant any attempt on the part of the automobile manufacturer to compete with the small parts producer. Carburetors, wheels, car-bodies, windshields, tires and tubes, brake-bands, roller bearings, bushings, upholstery, lumber, hub-caps, leather, all types of repair parts, etc., have been bought from outside producers who, even though in many cases forced to manufacture according to different designs, have a set-up which enables them to produce such parts more cheaply than the automobile manufacturer could possibly produce them. The Ford plant represents a notable attempt to avoid this type of industrial dependence on outside sources. Even here the attempt has not been entirely successful.[2]

Here, as in other similar cases, the manufacturers of parts have been, compared to the industries they supply, largely small producers. But it is not necessary to go to such extreme cases to find illustrations of how standardization

[1] Except where the quantity is very small.

[2] Witness the large number of Ford parts manufacturers producing parts for the old Model T car. Several parts of the new car, e.g., tires, tubes, carburetor, speedometer, etc., are bought from outside producers.

opens up profitable opportunities for the small plant. Many articles in common use, such as electric light fixtures, electric and gas appliances, drugs, toilet articles and perfumeries, etc., can be manufactured on a mass-production basis and still be conducted by small business concerns. Any industry in which the unit requisite for efficient mass production is comparatively small may find standardization to favor the existence of the small business unit, provided other considerations do not counteract these advantages.[1]

Tendency toward Large-Scale Production

Growth in industries adapted to small-scale production may be either by the simple addition of other units of the same size or character, without appreciable reduction in cost per unit of output, or by the assimilation of such a unit into a continuous chain of operations for the production of a commodity for which it is an integral and indispensable part.

If growth comes by addition of units, there is sometimes an advantage to be derived from the fact of joint management. If the management of the single unit can without loss of efficiency take care of the two or more units, overhead cost, being spread over a larger product, will be reduced per unit. While this advantage is sometimes counteracted, as the units multiply, by numerous inefficiencies arising out of "red tape" and the less personal and responsible nature of the administrative control over the operations, it is undoubtedly one of the most important factors making for the increase in the size of the plant.

If growth comes by way of integration with other process units, then, despite the fact that the individual unit can not be operated more efficiently, the assimilation may be worth while simply because of the advantages of the continuous process.[2] While each individual unit may be operated with maximum efficiency, the integration of the whole group may make possible a more efficient assembly because of the ability

[1] See Chap. III of this volume for description of types of standards used by different sized plants.

[2] An excellent example of an advantage accruing from such integration, whether or not under the roof of a single plant, is found in the universal number system for spare and repair parts of the General Motors Corporation.

to gear each unit to each other unit, preventing gluts and stoppages and the piling up of excessive stocks, and enabling generally more efficient production control.

Even in the case of so-called "natural monopolies," standardization has frequently played a significant part in eliminating the small competitor. Few of these monopolies existed from the beginning. Many cities are still served by more than one electric light, gas, water or electric railway system. The gradual elimination (by absorption by the larger firm or through mergers) of the smaller firms has come largely because the character of the services rendered necessitated a high degree of standardization, and such standardization could not exist without a high degree of co-operation and mutual agreement. The extension of telephone service necessitated standardization of telephone services, electrical characteristics of instruments, methods of putting through calls, rates, etc. This, in turn, depended upon a high degree of standardization in the equipment.

Somewhat the same result is obtained where many different factories manufacture according to the same specifications. Design of plant, equipment and product must of necessity be largely uniform. Methods of processing must be the same.

Even before this situation has come about, industrial usage may have narrowed the range of variability so that differences in design and methods of production are comparatively small and largely confined to unimportant details. Where this is the case, differences of design, differences in specifications and differences in processing increase the overhead burden of the industry taken as a whole, just as the same situation within the individual plant tends to slow down production and increase certain overhead costs.[1] It has been

[1] Occasionally a consumer organization is found advocating amalgamations or pooling of interests on the part of suppliers for this very reason. The following instance, cited by C. B. Lakenan, General Manager, Nevada Consolidated Copper Company, illustrates this point: "Late in 1923 interests with which I am connected determined to revamp certain heavy equipment. There are but two American companies manufacturing these parts. Both offered designs approximately the same per pound in each bid. There was nothing strikingly inventive or novel in the design. The draughting departments of both companies were equally capable of executing the work. Why did these manufacturers not attempt a joint design? They know the advantage of standardization better than the operator or engineer in that it would greatly reduce overhead expense and be of material benefit in cost

this fact that has lent such force to the simplification work of the Division of Simplified Practice and the standardization work of the American Standards Association.

Certain counteracting forces, however, may serve to lessen considerably this tendency towards the increase in the size of the business unit. Not infrequently, large consumers find that they can buy a better and more consistent quality product from a small supplier more cheaply than from a large one. Particularly is this the case where the large supply company is not itself the producer of the goods delivered. One large company, for example, bought wooden electric light poles from a number of small producers and retailed them to several large consumer companies. The latter found that they could secure a better grade of poles at a lower price by buying directly from the small producers.

Quite frequently it is possible for the small firm to profit from the popularizing of types of products through the national advertising of a single large firm or group of large firms.[1] Exclusive patent rights for the manufacture of small parts and fixtures may render the position of the small producer secure long after economic factors would otherwise have eliminated him.

Standardization and Consolidations

When differences in design, specifications and processes have been eliminated, two or three things may happen. Each manufacturer may attempt to increase his sales by an advertising campaign stressing differences that do not exist; concerted action may prevent price competition; or ruinous

reduction. But the manufacturer is not inclined to join with his competitor in any cooperative effort which has to do with sharing patents and technical talents except under mutually satisfactory arrangements which do not now exist. It would appear that standardization if carried to a really successful outcome must, in part, contemplate merging of interests, thereby giving equipment companies a free hand to use the most favorable assets of each and the best aggregation of technical talent of all. Such a pooling of interests need by no means throttle novelty of invention, which is important. On the other hand, the arrangement would, in my judgment, go a long way towards saving that billion dollars which it is claimed is wasted annually and must be paid for by the ultimate consumer." C. B. Lakenan, "Elimination of Waste through Standardization," *The Mining Congress Journal*, December, 1924, p. 553.

[1] For example, car accessories, physical culture shoes, so-called "violet ray" devices, electric household appliances of one sort or another, etc.

competition at cut-throat prices may ensue. Where the last result has been the product of such standardization, the tendency has been toward combination and mergers, for such competition may very shortly drive all parties into financial difficulties.[1]

Most frequently, however, the process of amalgamation does not wait so long. Standardization very early shows up the character of these duplications all along the line, and makes apparent the advantages of some sort of pooling of interests or of combination. This process may be considerably facilitated if, at the same time that standardization is going on, some one producer secures a more or less dominant position in the market and, through his ability to realize savings by cutting down on overhead, is able to undersell the small manufacturers.

Wherever standardization puts competition on a strictly price basis, the result may be cut-throat competition. And cut-throat competition characteristically provides one of the strongest incentives towards consolidation. Especially is this true in the United States, where anti-trust legislation and court interpretation have prevented any sort of formal price agreement. Formal consolidation, for the same reason, must stop short of effective monopoly.

The tendency towards consolidation will be particularly strong when an entire industry produces a single commodity or type of commodity, such as farm machinery, automobiles, phonographs or radio equipment. Here, mass production and the growth of a few large dominating units has forced the remainder of the industry to a merging of interests into a single unit or a group of competing units. Thus the phonograph industry in the United States has merged into two great groups, the Victor and the Columbia companies. The domination of Ford in the cheap car field was largely responsible for the formation, first, of the General Motors Corporation, and later, the Studebaker-Pierce-Arrow and the Dodge-Chrysler mergers. The first steps in the process of consolidation in the radio field have recently been taken with the merging of the Freed Eiseman-Charles Freshman interests.

[1] See, Homer Hoyt, "Standardization and Its Relation to Industrial Concentration," *Annals*, *op. cit.*, March, 1919; also J. M. Clark, "Economics of Overhead Costs," Chicago, 1923, Chap. VI.

The Warner-Stanley theatre merger is another example of the tendency.

Even where a varied or "full" line must be carried, standardization may forward mergers and consolidations in both the production and distribution fields. Plant specialization may so cheapen the processes of production as to enable a single company to offer a full line to its customers, although it is clear that such specialization involves the expense of cross-freights which are avoided with manufacturing a full line in each plant. In the distribution field, mass purchase of standardized goods has been the secret of much of the success of the grocery, drygoods and notions chain store systems. The recently announced expansion program of Montgomery Ward and Company indicates an intention to carry this same principle into the department store field. The plan calls for the establishment of some 1,500 stores, with at least one unit in every town in the United States having a population of 5,000 or more.[1]

The advantages of consolidation are even more obvious where standardization of equipment has combined with natural growth to create more or less of a natural monopoly in an industry formerly operating on a competitive basis. Such is the case with telephone and telegraph systems and, more recently, with radio broadcasting systems. Whether organized as a single business unit or not, effective and efficient operation calls for an intermembering of the system as though it were under single management. Where this situation exists, consolidation is almost unavoidable. This has been in large measure the secret of the growth of the Bell Telephone System and the Postal and Western Union telegraph systems. Recently it has brought these three systems closer together through the common use of the wires of the Bell System for certain long distance work, and has aided the rapprochement of the entire telephone and telegraph system with the radio broadcasting systems.

Some intimation of the existence of such a condition in the railroad industry underlay the first attempts to eliminate the cut-throat competition of the late eighties and early nineties. Railroad equipment and operation were highly

[1] *New York Times*, Oct. 17, 1928.

standardized, from roadbed, rolling stock and terminals to handling and general service. Companies were also becoming dependent on one another for through traffic and feeder lines. Should they be permitted to consolidate?

Public fear of undue restraint of trade on the part of the railroads led to the establishment of the Interstate Commerce Commission. As the tendencies in the direction of greater interdependence and more complete standardization continue, the powers of the Commission have been widened. They now include the power to permit merging of railroad companies into large competing systems. Recently, some persons have urged that the entire railroad system of the country should be run as a single integrated system or as a group of regionally integrated systems. The latter result is the objective, in part, of the proposed Great Northern-Northern Pacific-Chicago, Burlington and Quincy merger. While these companies compete with the Chicago, Milwaukee, St. Paul and Pacific lines over a considerable part of the total mileage to the Pacific Coast, there are large sections in which they have no competitors. The savings in operation would probably be enormous.

One business that is commonly not thought of in connection with standardization, perhaps because it has been from the beginning highly standardized, is the banking business. The standardization of types of services, methods of keeping books, forms and layout has been unconscious standardization, but nevertheless important. It may be that this fact of increasing standardization in the banking business has been responsible in part for the merging of banking institutions, which has been so signal a feature of the combination movement of the last decade.

Trade Associations and the Size of the Business Unit

Trade associations, as has been indicated before,[1] have become powerful forces in the standardization movement, both in the United States and abroad. The trade associations that have interested themselves in this movement include large and small producers, but tend, on the whole, to

[1] See Chap. V of this volume.

be more representative of the smaller producers. Trade association activity in this field has arisen in part because of competition between industries for certain types of markets or market areas, and partly to supply a central organization to carry on work that in the large plant is handled by a separate department. Service letters, general informative material and paid secretariats form the clearing houses for an exchange of ideas meant to forward the business of the membership. To the extent that trade associations in this respect supply a service otherwise unobtainable by the small plant, they may serve to strengthen the small producer in competition with the large.

Price-fixing and price agreements are, of course, prohibited by law in the United States. The courts will frown upon any action "tainted with an evident intent and necessary effect to violate the Sherman Law by artificially controlling those elements, in the cases under consideration, which are proved to be important in competition in the purchase and sale of commodities."[1] It seems to be quite generally agreed that standardization, *per se*, at least industrial (technical) standardization, does not come under this head.

As long as trade associations can continue to keep industrial standardization and simplification separated from any form of illegal price-fixing, they will probably continue to act as a force in keeping the size of the business unit smaller than it would be if the only alternative method of securing the advantages of standardization were the consolidation of separate plants. But it should be noted that this means abstracting a particular function from the concert of business operations and handling it as though the industries, for this particular purpose, were a unit. In other words, trade association standardization work means large-scale handling of particular business or industrial functions.

Summary

It can not be inferred, of course, that because the standardization movement coincides in point of time with the

[1] Benjamin Kirsh, *op. cit.*, p. 227. See also, National Industrial Conference Board, "Trade Associations: Their Economic Significance and Legal Status," *op. cit.*, Chap. VI.

recent great merger movement, there is a necessary causal relationship between the two in all cases. But the opinion that in many, if not in most cases, the relationship between the two is direct and intimate seems to be convincingly supported by the observation that most of the mergers, completed and in prospect, involve industries already highly standardized. When this is coupled to the fact that the industries already dominated by large-scale producers are highly standardized and that no cases have come to hand where standardization, intelligently carried through, has failed to increase the scale of business operations, it seems impossible to avoid the conclusion that standardization does in a significant and definite fashion favor growth in size and the large plant over the small. A causal nexus is difficult to establish for the reason that it is equally true that increase in the scale of industrial operations favors standardization. The relationship is reciprocal.

CHAPTER XIV

STANDARDIZATION AS AN AID IN THE STABILIZATION OF BUSINESS

FLUCTUATIONS in business may be either accidental, highly irregular in timing and haphazard, or they may be recurrent and predictable within fairly close time limits. The expression "business rhythms" covers only those fluctuations in the physical volume or the money value of the output of any business or industry in which the variation occurs with some degree of regularity. It is not necessary to assume absolute periodicity but only that the variations occur, in phase, timing and in amplitude, with sufficient degree of regularity to make a common or significantly related set of causes the plausible explanation for all the fluctuations of the same type. Only where this is the case can such fluctuations be predicted, for only from known *causes* can one predict known results. And it is likewise only when this is the case that one can administer or experiment with *cures*.

Types, "Causes" and "Cures" of Business Fluctuations

These recurrent business fluctuations are of several types—daily, weekly, seasonal, annual, cyclical and secular. Some of these fluctuations follow cycles prescribed by the character of definite and known causes. The daily cycles of electric current consumption and of subway traffic are, respectively, the products of the natural phenomenon of alternating light and dark and the conditioning factors of city life. Certain weekly cycles cluster around the institution of the Sunday holiday, and others around such habits as sending laundry on Monday, buying fish on Friday, getting haircuts on Saturday. Seasonal cycles are largely a function of climatic changes,

which necessitate growing of the crops during certain seasons, harvesting in others and planting in others. Seasonal cycles also affect many other industries and afford the basis for social customs, such as going to summer resorts and taking trips to Florida and California in the winter.

In some cases where causes of variations are known, cures are possible; in other cases, they are not. In the case of business cycles, neither the cause or causes nor the cures are known, or at any rate agreed upon with any degree of finality. But much is known about the character of the fluctuations, the most important contributing factors, the sequence of developments, etc. It is not the task here, in dealing with the extent to which standardization may aid in the process of stabilizing business, to describe the causes, the course or the general proposals for mitigating cyclical or other types of recurrent business fluctuations. Only where standardization techniques may affect these fluctuations, either by way of increasing or decreasing their frequency or amplitude, will they be discussed.

Standardization and Statistics

Accurate and fairly exhaustive statistical information is the *sine qua non* for the analysis of business fluctuations on a quantitative basis. The difficulty of collecting data, the lack of uniform cost accounting systems and the inaccuracy of the data collected all hinder such a statistical study of fluctuations. Standardization can affect all three of these problems.[1]

Standardization of accounting methods makes data collected from different sources comparable. Where accounts are subject to public inspection, there has been a significant trend towards standard methods. Railroads, banks, public utilities are now using for the most part standard accounting systems. Trade associations have begun to take a consid-

[1] "Standardization and publicity give the statistician what he wants." W. C. Mitchell, "Business Cycles, the Problem and Its Setting," New York, 1928, p. 199. Professor Mitchell ascribes the fact that "the statistical study of business cycles has had its headquarters in the United States" to the fact that here the statisticians have "had fuller statistics to work with than were available in other countries . . . partly because of the highly standardized character of American products."

erable interest in the development of standard cost accounting systems.[1]

It has been characteristically true that it is "easier to compile reports for the highly standardized raw materials like coal, petroleum, and agricultural produce, or for partially fabricated materials like pig iron, spelter and cotton sheetings, than for the vast variety of finished goods like machinery, clothing and household supplies."[2] These latter goods are found on the market in so many varieties, produced in so many different ways and under such widely varying conditions, that the statistician's task was well-nigh hopeless from the start. While it is true that conscious standardization to date has been applied almost exclusively to producers' goods, the rise of chain-store systems has unavoidably brought about a considerable degree of standardization in consumers' goods. The further this trend progresses, the easier it will be to gather reliable statistical data.

Where raw and semi-finished materials are bought on widely-known specifications, processed according to standard methods and incorporated into standard products, accurate cost accounting becomes, within limitations, a real possibility. Where standard cost accounting systems are applied on the basis of thorough technical standardization, the statistician is supplied with relevant and comparable cost statistics, impossible without such standardization.

Besides these advantages to the statistician, such data furnish the basis for more intelligent decisions of business policy. In addition, there is the tendency, where standard accounting systems accompany technical standards, to focus attention upon incidental wastes that otherwise would escape notice.

The standardization of statistical techniques and methods of representation in graphs, charts and tables is necessary, especially with the growth of the body of statistical materials, in order to make the results of statistical investigation

[1] Examples of trade associations having or promoting standard cost accounting systems are the Association of Manufacturers of Chilled Car Wheels, Machinery Builders' Society, National Association of Ice Cream Manufacturers, National Association of Wool Manufacturers, Silk Association of America, United Typothetæ of America, etc.

[2] W. C. Mitchell, "Business Cycles, the Problem and Its Setting," *op. cit.*, p. 198.

intelligible to the layman. Since the layman is frequently affected, both as a consumer and in some capacity in the industrial system, in a manner which makes his cooperation more or less indispensable, the development of standard statistics may become very important. The American Statistical Association has devoted considerable time and effort to such standardization. Part of this work has been done in cooperation with the American Standards Association.

Manufacture to Stock

Perhaps the most important contribution standardization can make to the stabilization of business is making possible manufacture to stock. Particularly is this true with reference to seasonal fluctuations, since cyclical fluctuations are, in the main, of too long duration to make this expedient possible for most manufacturers on account of the drain on financial resources such a policy demands.

In the first place, it should be noted that the fact that standardization makes possible the reduction of capital tied up in stocks during times of full production means that when depression sets in the financial resources necessary to meet the contingency are larger and more liquid. If a manufacturer is unable to deliver "three carloads of wagons in spite of the fact that (he) had 12,000 wagons in stock,"[1] the money tied up in stocks of finished goods manufactured at high costs become a serious liability when depression occurs.

But once a depression occurs, everything is to be gained from the point of view of both the manufacturer and the general public if production can be kept as near to normal as possible. Many industries have found it quite possible to regularize production, where the fluctuations are of a seasonal character, by manufacturing standard products or component parts to stock. The Portland cement industry, which manufactures a highly standardized product, has found that it could practically eliminate seasonal fluctuations in production and in employment, even though shipments were highly seasonal.[2] The Marian Steam Shovel Company allows excess

[1] *Mechanical Engineering*, Editorial, "Standardization," August, 1922, p. 546.

[2] "Seasonal Operation in the Construction Industries," New York, 1924, pp. 168–170.

production during depressions "to accumulate as standard stock to be drawn from, to take care of the excess demand over the production schedule during peak demand periods."[1]

Even where the assembled product can not be manufactured to stock, standard and interchangeable component parts frequently can be. If 90% of the assembly can be made to stock during off-peak periods, the cost of handling the peak demand can be cut by drawing from stock rather than speeding up production, and workers can be concentrated on assembly rather than stock. There is the additional consideration that speeding up production unavoidably increases waste and spoilage even in the standard stock.[2]

Quite frequently the production schedules of seasonal commodities that can be manufactured by the same company, but for which the seasonal peaks are different, can be dovetailed so that a constant working force and a minimum of plant and equipment can handle the output. One company found that it could utilize the same plant and personnel for manufacturing agricultural tools and implements, for which the spring and summer demand was heavy, and children's sleds, for which the winter demand was heavy. Between peaks, standard parts could be made to stock. The device of dovetailing production schedules for the two standard types of commodities had the additional advantage that it shortened considerably the period in which money was tied up in the standard stocks.

Somewhat the same result can be achieved in industries that find it necessary to manufacture a considerable number of special and non-standard products. The making of standard products and component parts can be dovetailed with the making of specials, which have their own demand peaks.

Where an industry manufactures equipment or machinery for which there is a world market—such as automobiles, agricultural and electrical equipment—but for which there is a fairly definite seasonal fluctuation in demand, it is possible to offset the falling-off in one hemisphere by the increase in another. The demand peaks for agricultural machinery

[1] Metropolitan Life Insurance Company, "Steadying Business," Bulletin No. 2, 1928, p. 4.

[2] See Chap. XI of this volume.

are almost six months removed as between the regions north and south of the equator. Such wide markets exist, in the main, for the manufacturer who produces on a mass-production, standardized basis.[1] Where such wide markets exist, it is further possible to utilize excess productive capacity in off-peak periods by the manufacture of standard repair parts. Without rigid and far-reaching standardization, this can not be done to any decided advantage.

It is less certain that the device of manufacturing to stock can be employed to advantage in mitigating the effects of business cycles. For one thing, the longer the period of depression the larger will be the funds necessary to finance production, because of the absence of immediate returns. And for another thing, standard goods are frequently more apt to have their prices slashed than are non-standard, so that when a recession occurs the incentive to maintain production may be less in the case of standard goods industries.

There are several reasons why the prices of standard goods are apt to be most depressed by a general decline in prices. In the first place, standardization has been mainly applied, to date, to the construction industries and to producers' goods. It is a widely known fact that these industries are, generally speaking, the greatest sufferers in a depression. The business of the industries manufacturing producers' goods is compounded of machine and parts replacement, on the one hand, and additions to plant and equipment, on the other. A decline in the rate of growth of the industries using the equipment, even though such growth has not declined in an absolute sense, brings about a serious depression in the construction industries.[2] Added to this is the fact that for many industrial processes, replacement and repair are, depending upon the types of equipment used, more or less indefinitely postponable expenses.

This does not mean, of course, that in the heavy produc-

[1] There are, of course, important exceptions to this statement. Certain producers, individually small, may manufacture goods that for the industry as a whole are highly standardized and enjoy, in this respect, market advantages similar to those realized by the large producers. Farmers, characteristically producing on a comparatively small scale, cater to world markets through the standardization of grain, tobacco, cotton, fruit, etc.

[2] See, W. C. Mitchell, "Business Cycles and Unemployment," New York, 1923, pp. 12–13; also J. M. Clark, *op. cit.*, Chap. VIII.

tion industries the standard equipment and repair parts manufacturers suffer more severely than the non-standard manufacturers, but merely that as between the fields in which standardization has been most widely applied and least applied, the former is in the more precarious position. But there is another factor which, under certain conditions, may react against the stability of the manufacture of standard goods.

Generally speaking, it is true that standardization makes possible the utilization of expensive machinery, plant and other facilities on a much larger scale than before. This involves a shift in the cost structure so that overhead costs come to assume a position of great importance in contrast to variable expenses. Under this circumstance it may pay, even in "normal" times, to accept additional business at somewhat less than the total cost of doing business, provided the returns pay something on the overhead. The incentive to do this becomes stronger as idle capacity increases. In periods of slack business this idle overhead offers an incentive to cut prices, for the reason that any return that pays something over variable expenses is better than no return at all. So that, under the conditions which standardization promotes and under which it thrives, the incentive to cut prices is probably greater than elsewhere.[1]

But there is another side to this picture. During the period of rising prices, costs tend to rise very rapidly after normal capacity is reached. Before this point, production to stock in anticipation of increased demand is possible only on the assumption that the market will at some future date absorb the type of goods produced. Only when the product is highly standardized will such an expectation be fully justified. And if this policy is pursued, it means that the manufacturer can continue to supply demands for a time even after demands exceed current capacity.

[1] This generalization should not be taken to imply that standardized industries are more affected by cut-throat competitive tactics than industries catering to fashion or industries doing entirely a specialty business. It is argued here only that as between standard and non-standard goods *of the same type*, the standard goods tend to compete, by definition, on a price basis solely, and that this fact opens the way for disastrous cut-throat competition. Because of the temptation to "unload" as fast as possible in time of crisis, it would seem, on this basis alone, that manufacturers of standard goods would have to take unusual precautions to prevent the ruthless cutting of prices.

It is also recognized that after capacity has been reached, and sometimes before, the rising market and the increased output permit numerous wastes—perhaps individually insignificant but as a group very important—to creep into the production processes. Because standardization rests basically upon a high degree of specialization of process and output and because it necessitates careful and scientific scrutiny of purchases, the character of the standardized plant focuses attention much more clearly upon the sources of these wastes than is possible in the non-standardized plant. Mass production, high ratio of overhead costs and relatively narrow profit margins make imperative close attention to the conditions under which that profit margin can be maintained.

This same technique would in turn seem to subject a policy of expansion to much closer scrutiny. Since such close scrutiny must needs involve considerable attention to the market, a policy of retrenchment might be expected earlier in standardized plants than in others.

The very fact that standardization gives rise to a condition in which cut-throat competition may so easily arise gives all such industries an added interest in seeing that such a situation does not arise. Trade association literature shows that those associations that are most interested in standardization are also showing an unusually great interest in business stabilization. The conditions that give rise to standardization seem to be those that give manufacturers an increasing interest in uninterrupted and stable conditions for business in general.

As standardization spreads into different industries supplying a national and an international market, there is a tendency to gear production to the market requirements and to base policies of expansion on long-time considerations rather on the immediate demand. These industries manufacture to fill advance orders, so that, assuming a careful eye is kept upon the danger of duplicate orders and cancellations, they are less apt to have large quantities of stocks of finished goods on hand in the event of a falling-off in business than they would have otherwise.

Although it may not be possible to maintain production at any normal rate during a period of depression, it is only

the manufacturer producing standardized materials and parts who can take the chance of producing without an immediate market. And the fact that he is producing to some market, whether immediate or distant in point of time, offers a basis upon which to secure financial backing. The goods, even though in stock, are collateral upon which the value is certain to be realized sooner or later. Of course, this result is subject to the proviso that the commodity produced to stock is not of such a perishable nature that depreciation costs more than outweigh the advantages of manufacturing during a period when costs are at a minimum. In any case, depreciation charges should be counted as a loss attendant upon the pursuit of such a policy.

Regularization of Employment

Anything that may aid in the process of regularizing production in the first instance, regularizes employment, bolsters up consumers' purchasing power, and in turn provides the market necessary to keep production processes going. To the extent that standardization may provide information leading to the control of business fluctuations or a technique of manufacturing to stock, it is an indispensable aid in regularizing employment.

Standardization has a tendency, also, to functionalize the working force. Standard processes, parts, materials, etc., provide the basis for time and motion studies to adapt workers to the jobs to be filled. Those industries that are highly mechanized and highly standardized employ a considerable staff of overseers, repairmen, technical experts and routine workers whose labor is necessary regardless of the rate of output. In other words, the wages of this group come to take on the character of overhead costs. Generally speaking, the higher the ratio of overhead to variable cost, the larger the percentage of the working force whose wages are an overhead expense to the company. To the extent to which this is true, the mere fact that standardization promotes such a shift in the cost structure means that standardization promotes regularization of employment.[1] Not all

[1] A word of caution is required here. Over a long period of time, with the growth of business, additions to plant and equipment may mean that overhead costs vary

overhead cost is *constant*, however. Some overhead costs, such as depreciation, are more or less indefinitely postponable.

Perhaps more important is the fact that the functionalizing of the job under scientific management procedure cuts down labor turnover. Such evidence as is available seems to support the conclusion that the most highly standardized industries have, relatively speaking, the lowest labor turnover. And high labor turnover is one of the most important causes of that type of chronic unemployment that exists as a residue regardless of business fluctuations.

One type of standardization, simplification, is most likely to be adopted in times of falling prices. It is fairly easy to introduce this type of standardization very quickly. To the extent that it may make possible the continuation of business where otherwise it would not be possible, this type of standardization may act as a stabilizer of business and employment.[1]

It is also true that where standardization is a matter of common industrial agreement, it tends among other things "to moderate the influence of competition as a cause of unemployment. For instead of competing with each other, the various undertakings in a given branch of production will agree to specialize in the fields best suited to each of them and to standardize their products. The result will be more stable employment."[2] And, it should be added, the com-

more than variable costs. The same condition would obtain if, during a crisis, overhead was ruthlessly cut. This is not, however, a valid objection to the argument presented above. Standardization fosters, and is fostered by, a condition in which overhead costs over a period of time show a steady percentage increase with reference to variable costs, taken at different time intervals. The concept of overhead costs must be restricted, for the sake of intelligibility, to those costs that vary relatively with output *over a short period of time*.

[1] This generalization is made in the face of the well-known fact that depression and periods of falling prices are "buyers' market" periods and that at these times the temptation to produce whatever can be sold, whether standard or not, is ever present. The business man may decide to go out after orders, without paying any particular attention to the cost of filling them, or he may decide to cut the cost of producing to the minimum by simplifying his line in order to produce only those goods in greatest demand. Granting adequate knowledge of his own manufacturing costs, his decision at this juncture will rest largely upon the degree to which his manufacturing processes and output have been already standardized and upon the comparative savings and costs attendant upon the two alternative procedures. The psychology of recession and depression is one that lays emphasis more on costs and retrenchment than upon output and markets.

[2] Henri Fuss, "Rationalisation and Unemployment," *International Labour Review*, June, 1928, p. 808.

petitive practice first to be enjoined by cooperative effort is cut-throat competition.[1]

On the reverse side of the argument, it is frequently contended that standardization is a chronic source of unemployment in that it involves the permanent displacement of labor over and above that reabsorbed in the manufacture of the machinery and in the tasks incident to the introduction of standardization. While this is probably true, the argument is no different from that to be made against any change that increases industrial efficiency. The answer is to be found, in most such cases, in cheaper production, increased production, wider markets, greater demand and reabsorption of the excess labor supply. The only difference may lie in the time lag before this adjustment takes place. There is no reason to believe that this time lag is any greater where increased efficiency is due to standardization than in any other case. The fact that standardization is to be found in the industries with the most rapidly expanding markets, such as the automobile, electric, building materials, transportation and communication industries, would seem to render plausible the opposite conclusion.

Where the demand for the product is relatively inelastic, standardization has the effect of releasing capital and labor for other fields of production. Lower prices release purchasing power for other commodities. These factors aid in the cheapening of other production processes, in turn encouraging the introduction of standardization.

Summary

The following general conclusions may be drawn from the above discussion:

(1) Standardization can be used to mitigate business fluctuations of the recurrent type.[2] It has been very suc-

[1] What of the legality of these measures? It remains to be seen what the legislature and the courts will decide to do, but it may be worth pointing out that the Government has never, either through legislation or court decisions, expressed the opinion that cut-throat competition is a healthy or worthwhile business practice.

[2] There are, of course, many business fluctuations of a fortuitous, accidental and unpredictable nature incident to the operation of almost every business enterprise. A sudden falling-off in business need not disturb the routine of production of standard goods, provided it is consistent with general market conditions to assume that

cessfully employed in moderating seasonal fluctuations in certain industries and it has been less successfully employed in moderating cyclical fluctuations. But the conditions giving rise to the adoption of standardization are the conditions that encourage regularization.

(2) While the dangers of profits being wiped out by business fluctuations are greater when standardization techniques are widely used, the gains from the regularization are probably greater to the standardized industries than to any others.[1]

(3) Because standardization is essentially a cooperative process in most industries, concerted action against competitive price-cutting tactics (cut-throat competition) may be expected. And any action that prevents the rapid slaughtering of prices in times of depression, just as any action that prevents competitive bidding up of prices during the period of revival and prosperity acts to modify the severity and perhaps the duration of cyclical fluctuations. Because of the character of the cost structure under standardization, the incentive to prevent rapid fluctuations in prices is very great.

(4) To the extent that standardization may, either directly or indirectly, promote regularized production, it acts to stabilize employment. Stable employment acts to

the condition is a temporary one. An increase in demand, on account of the same or similar cause, can sometimes be met out of the storehouse, and stocks of finished goods can be allowed to fall, temporarily, more than usual. Or, as is more likely to be the case, orders can be allowed to pile up or fall off in advance of delivery, on the assumption that these accidental and unpredictable variations in business will cancel out over a period of time. Needless to say, only under standardization can orders for future delivery be taken far in advance from a wide market.

[1] This may seem, to the critical reader, tantamount to the admission, when all is said and done, that standardization encourages cyclical fluctuations. Support is lent to such a contention by the reflection that standardized industries are typically large-scale industries and those showing the greatest degree (widest amplitude) of cyclical fluctuation. It would appear statistically that standardization (and large overhead) tend to increase cyclical fluctuations. In answer to this it is small comfort to argue that the fluctuation is smaller than it would be without standardization, because nobody knows what would have happened in the absence of what did happen. Yet, as has been already pointed out, this argument sets up a false and misleading comparison. The case does not lie between industries, but between producers within given industries. And when this is taken as a base there seems little room for argument, for those individual producers in industries who have standardized most completely have been, almost uniformly, the successful producers in times of business depression and out. Materials for statistical verification of this statement are not at hand, yet such materials as there are strongly support that conclusion.

regularize consumers' purchasing power, and hence to reinforce any tendency towards stabilizing production.

(5) The production industries stand to gain the most by any type of stabilization that will make the rate of increase in consumers' purchases a constant. The more standardization of consumers' goods is applied to lines in which the demand is relatively inelastic, and the more standardization transforms elastic demand into inelastic demand by making goods cheap and thereby changing luxury commodities into necessities, the more the fluctuations in the rate of growth in industry in general are apt to smooth out. Any advantage that accrues to the manufacturers of consumers' goods through such standardization will, consequently, be doubly advantageous to the makers of producers' goods. By moderating the extreme fluctuations in the production curves of producers' goods, one of the worst features of cyclical fluctuations will be partially eliminated.

CHAPTER XV

STANDARDIZATION AND THE ULTIMATE CONSUMER

TRADE brands are today practically the sole guide to the consumer seeking good quality products at reasonable prices. In many cases, these brands are sufficient guarantees. The habit of relying upon trade brands comes from long experience in which such brands have been for the most part sufficiently representative of quality, apparently, to justify the confidence of the consumer in the brand. The custom of branding goods with the name, insignia or trade slogan of the producer originated for the very purpose of enabling the consumer to differentiate between the unreliable and the reliable producer. In the time of the Guilds, the consumer was entirely at a loss without the trade brand; by the trade brand, the producer certified the quality of his product.

This custom of buying by trade brands has been developing for hundreds, if not thousands, of years.[1] It is to be found in an elementary form in ancient times when quality of goods was associated with place or person (city, guild or merchant) of origin. Damascus steel, Toledo swords, Arabian perfumes, Mocha and Java coffees and Grecian pottery were terms expressing excellence in ancient times. Even today, Persian rugs, Chinese silks, Javanese Batiks, German dyes, Sheffield steel carry the definite connotation of excellence as associated with the place of origin. People still have as much confidence in Persian rugs as they do in modern patented goods of long-standing reputation and known quality.

In modern times, under the pressure of mass production and mass distribution, the use of trade brands has culminated in national advertising. The number of manufacturers and

[1] See, National Industrial Conference Board, "Public Regulation of Competitive Practices," New York, 1925.

the bewildering variety of goods of the same general type on the market have brought in a confusing medley of trade names, brands, insignias, slogans. Competitive advertising, where such has taken place on any considerable scale, guarantees the market to the producer able most frequently and most insistently to keep his brand before the eyes of the public.

As has been pointed out before,[1] this process has in many fields received considerable criticism recently. There is a definite tendency towards group advertising, built up on group standards of excellence, to displace that of individual competing producers. This tendency has developed because of the rising cost of distribution, of which advertising is an important item; the recognition that an established reputation does not prevent deterioration of quality after the reputation has been established; the fact that the technique of advertising may not always stay close to the relevant facts of the product sold; and the fact that competition between industries is coming, in some fields, to replace competition between individual producers in such industries.

Out of this situation has come the movement cooperatively to establish standards that will enable the consumer to buy more intelligently, with the belief that, in the long run, the elimination of much of the prevailing confusion on the market will redound to the decided advantage of the business community. The fact that a growing minority of consumer interests is becoming articulate on these matters is serving to accelerate a movement that is as yet scarcely under way.

Feasibility of Standardization of Consumers' Goods

Formal, deliberate, selective standardization has been mostly applied, up to the present time, in the procurement, manufacture and simplification of producers' goods. It is quite natural that this should be the case, for it is in this field that large-scale production, heavy fixed investment and a high degree of automatic operation are most characteristically required. Also, the needs of industry, particularly machine industry, have given rise to more exact and

[1] See Chap. XII of this volume.

rigid purchase requirements than are demanded by ultimate consumers. Ultimate consumers, and ultimate consumer organizations, such as charitable institutions, colleges and universities, municipal, state and federal governments, with the exception of the Army and Navy departments, have only lately begun to look to standardization as a means of securing required qualities and lower prices.

The objections are met at the outset that end consumption goods[1] are either not subject to the technique of standardization or that they should not be standardized. The first of these objections can, of course, be dismissed with the observation that any commodity produced in large quantities can be standardized. The second objection can be dismissed with the observation that a great deal of more or less unconscious standardization of consumers' goods has taken place without any serious protest being raised by the mass of consumers. But there is the additional answer that it depends upon what is meant by standardization and where the line is to be drawn.

While it is impossible to get unanimity of opinion on the matter, there is at any given time a very large proportion of the whole range of consumers' goods concerning which, by general assent, no appreciable measure of individuality is required. Over a period of time, it is conceivable that a larger percentage of consumers' goods must meet a demand for originality and individuality not possessed by the standardized goods. Or, it is conceivable that the reverse may happen.

It is difficult, however, to cite any product—producers' or consumers'—which can not be or has not been, in some particular, standardized. The very fact that consumers' goods have names, however irrational, which are commonly understood, indicates the existence of some degree of standard nomenclature. Dress fabrics are or may be standardized as to type of material, method of working up, purity or fastness of dyes used. The most eccentric artist may have the most exacting standards for his clay, paints and canvas. Stan-

[1] The term "end consumption goods," or merely "consumers' goods" is used here in the conventional sense, as those goods which are purchased for one's own use, and without the object of resale or use for making a profit.

dardizing these properties still more rigidly will probably meet with no objection on the part of the artist. Dimensional standards, such as garment and shoe sizes, permit of almost infinite combination and recombination, and size becomes a definite and significant term.

It is, further, probable that once it is understood what standardization really means by way of price, even where the product in all its essential characteristics is highly uniform, the demand for individuality of product may in part disappear. Highly standardized electric light bulbs, automobiles and component parts, refrigerators and ice-boxes, doors and windows, electric and gas appliances and fixtures, bath tubs and plumbing equipment may be monotonously alike, but they are correspondingly economical. For the most part, standardization does not preclude æsthetically satisfactory design for products that do not possess great significance in the artistic world, but whether or not such is the case, the mass of the people could not possess these objects without standardization and mass production.

While a considerable degree of standardization has come out of the conditions of manufacturing for a large consumer market, formal, deliberate, selective, cooperative standardization has, as was pointed out above, been little applied in this field. If and when applied, it can do no more than to facilitate a process that is already under way in many industries because of the characteristics of production, and to counteract a tendency towards diversification, much of which is quite useless, and its attendant rising costs. And it is in this sense only that the questions are here raised of what has been done in the standardization of consumers' goods, how consumers have been benefited, and what is the general trend.

Present Standards of Consumers' Goods

Several groups have interested themselves in the standardization of end consumption goods. The American Standards Association has under way two projects of interest to the ultimate consumer—standardization of sheeting and standardization of ice-boxes and refrigerators. The Deut-

scher Normenausschuss has standardized paper sizes, typewriter parts, sealing wax, stove parts, aluminum kitchen utensils and bottles.[1] The Czechoslovak society for Standardization has standardized door and window frames, and the shapes of sugar lumps.[2] The Russian Standards Committee has standardized, or is standardizing, various types of foodstuffs from bread to vodka, cigarettes, paints and dyes, soaps and petroleum products, window glass, textile materials and fabrics, furs, writing paper, wireless receivers and other end consumption goods.[3]

The 1928 Standards Yearbook mentions over sixty trade associations directly or indirectly engaged in the task of standardizing consumers' goods.[4] The American Gas Association tests gas ranges and other gas appliances. "The American Drug Manufacturers' Association, and the American Pharmaceutical Manufacturers Association, have submitted to the Food, Drug, and Insecticide Administration of the Department of Agriculture, their fourth report containing recommendations for tolerances on certain medicinal tablets."[5] The Underwriters Laboratories have set up standards (mostly safety standards) for automobile equipment, gases and oils, building materials, chemicals and electrical apparatus.[6] The National Electric Manufacturers' Association has set up standards for radio equipment.[7] The Association of German Bicycle Manufacturers has been engaged in setting up standards for the bicycle industry.[8]

Perhaps the most interesting of all these association activities involving standardization of consumers' goods is that of the United States Pharmacopœial Convention, whose prime function "is to establish uniform standards for the use of those engaged in the practice of medicine and pharmacy in

[1] *Sustaining Members Bulletin*, *op. cit.*, April 26, 1928.

[2] *Bulletin of the International Management Institute*, *op. cit.*, January, 1928.

[3] See, Moscow Standards Committee, "The Activities of the Standards Committee," Moscow, 1928.

[4] "Standards Yearbook, 1928," *op. cit.*, pp. 258–352.

[5] *Monthly News Bulletin*, *op. cit.*, May 15, 1928.

[6] For further details, see, W. D. A. Peaslee, "The Standardization Activities of Underwriters' Laborarories," *Annals*, *op. cit.*, May, 1928, pp. 60–65.

[7] See, National Electric Manufacturers' Association, "Handbook of Radio Standards," 3rd ed., September, 1927.

[8] *Sustaining Members Bulletin*, *op. cit.*, Jan. 4, 1927.

the United States whereby the identity, strength, quality, and purity of certain recognized medicines and drugs may be accurately determined."[1] These standards are incorporated in the United States Pharmacopœia, which is revised every ten years. The members of the Convention represent state and federal medical and pharmaceutical associations, all medical schools and schools of pharmacy, and the various national medical and pharmaceutical manufacturers', distributors' and users' organizations. A companion book, the National Formulary, containing "definite formulas for preparations that are sufficiently used in medical practice," and providing "standards and tests for the identity, quality and purity of the essential ingredients used in compounding same not otherwise provided by a recognized authority . . ." has been worked out by a special committee of the American Pharmaceutical Association.[2] These two pharmaceutical and medicinal guidebooks are used by every retail druggist in the country. They are regarded as official by the Federal Government in its administration of the Pure Food and Drugs Act.

Many private firms have worked out standards for consumers' goods as a part of their standardization work. The General Motors Corporation reduced specifications of standard items, such as screws, bolts, etc., from 13,000 to 2,000.[3] The standardization work of the Ford Motor Company is well known. The General Electric Company and the Westinghouse Electric and Manufacturing Company have standardized electric light equipment, such as light bulbs, fixtures, appliances and small electric motors used in vacuum sweepers, sewing machines, etc. The testing laboratory of Montgomery Ward and Company, of the Filene department stores, and the proposed laboratory of the National Retail Drygoods Association, all look towards the establishment of standards for end consumption goods in which the retail outlet will control the situation.

The Association of American Colleges, the federated Jewish Philanthropies in New York City, the American Hospital Association, the American Medical Association,

[1] "Standards Yearbook, 1928," *op. cit.*, pp. 386–387.

[2] *Idem.*

[3] *Cosmopolitan*, November, 1925.

and other similar bodies have set up testing laboratories, or have effectively used purchase specifications, or both. The American Home Economics Association has recently become interested in the question of consumer standards and specifications. A Consumers' Club has recently been organized in New York City, with the object of giving advice to club members in the purchase of standard consumption goods.

A very large proportion of the end consumption goods on the market have been tested in the Government laboratories, and standards have been drawn up, in thousands of cases, for the guidance of the Government in its own purchasing. The Federal Government, as stated before, permits the use of its findings by states and municipalities, but not by individual consumers. In its promotional work, the Bureau of Standards has concerned itself very little with end consumption goods. There are three or four exceptions to this generalization but, in the main, the Division of Simplified Practice, the Commercial Standards Unit and the Division of Specifications have confined their work to intermediate or producers' goods.

Organized consumers (ultimate consumers) are generally not represented in the deliberations of national bodies, trade associations or the Federal Government. This is not quite so true of German standardization work, especially as carried out under the auspices of the Deutscher Normenausschuss, as in the United States, particularly in the government work. The American Standards Association in its projects on sheets and sheeting and ice refrigerators has included, probably for the first time in this country, organizations effectively representing the ultimate consumer.

In addition to the foregoing, there should be noted a considerable body of governmental negative standardization which is of interest to the general consumer. The Pure Foods and Drugs Act, the mandatory standards set up by the Department of Agriculture, states and municipalities in the inspection of foodstuffs of all sorts, rules looking to the safety and health of the population at large, all involve the establishment of standards. This branch of standardization of interest to the ultimate consumer will be enlarged upon below.

Direct Gains to Consumers

It would be impossible, of course, even to attempt to estimate the monetary significance to consumers of this formal standardization work. Direct savings, however, may come by way of better knowledge of materials, reduced first cost, and reduced cost of repair parts, service and maintenance.

It is a widely known fact that the average consumer's knowledge of market values is so hopelessly inadequate that a persistent sales campaign can make him believe almost anything. The greater the multiplication of varieties, sizes and terms, the worse his confusion becomes. In the long run, it would seem to be to the advantage of business in general for the consumer to know more about real qualities. The first step in this direction must come in standardization of terms. What, for example, does 99 44/100% pure mean? Does solid mahogany mean all mahogany or a solid table with a mahogany veneer? What does one buy when one purchases an acre of land?[1] How big is a size eight shoe, a 7⅛ hat, a size 34 dress?[2] How fast does one really go when one drives 85 miles per hour by the speedometer purchased on a specification tolerating only plus or "fast" errors? What is meant by "Satisfaction or your money back"? What is raw silk; a part-wool blanket; oak-tanned leather? These, and a thousand other terms and slogans, are examples of expressions the average consumer thinks he understands, because he has heard the words before, but about which there is little or no unanimity of use. Standard-

[1] An interesting example of confusion in such an elementary matter is cited in *The Managing Engineer* (London) for August, 1919, p. 80, in a discussion following the presentation by Mr. J. Fern of a paper on standardization. The following table shows what one would buy were he to purchase an acre of land in different parts of the British Isles:

The English or Imperial Acre	= 4,840	sq. yds.
The Scotch Acre	= 6,150.4	" "
The Irish Acre	= 7,840	" "
The Welsh Acre (Erw)	= 4,320	" "
The Welsh Stand (another part of Wales)	= 3,240	" "
The Leicestershire Acre	= 2,308¾	" "
The Lincolnshire Acre	= 400	" "
The Cheshire Acre	=10,240	" "
The Westmoreland Acre	= 6,760	" "

[2] The National Retail Drygoods Association has recently taken up the subject of size standardization.

ized nomenclature would seem to be the first step in the elements of consumer education.

The savings to the consumer on original cost are of great significance in some cases. A saving of some two hundred and thirty dollars per house through the standardization of drawings and specifications for doctors' cottages has been cited.[1] The General Electric Company announced recently another reduction in the prices of Mazda Lamps, bringing "the average price of all Mazda lamps to 49.4 per cent less than in 1914."[2] This reduction is ascribed to standardization of type. It is estimated that the Model T Ford produced by hand would have cost more than one hundred thousand dollars. Mass production and standardization brought this price down to about four hundred dollars.[3] A manufacturer of filing cabinets found it cheaper to manufacture all his cabinets with a first grade lock than to manufacture half with locks and half without.[4] The Director of the Architects House in Dessau, Germany, estimates that standard interchangeable building parts and materials would bring marked reductions in the cost of the average family dwelling,[5] while the National Builders Supply Association finds that "Appraisal engineers are authority for the statement that a

[1] Sullivan W. Jones, *op. cit.*, 1924, p. 10.

[2] "This is the third reduction in prices since the new inside frosted lamps were introduced in 1926. The reduction lowers the price of 25 to 40 watt lamps to 23 cents each, the 50 and 60 watt sizes to 25 cents each, and the average price of all watt sizes to 25 cents each, and the average price of all Mazda lamps to 49.4 per cent less than in 1914." The *New York Times*, March 23, 1927. Although these figures represent no adjustment for changes in price level, a preceding announcement, made in the *Monthly News Bulletin* of the Division of Simplified Practice, January, 1927, found that "the prices of Mazda lamps are now 44 per cent below the 1914 prices, although there has been a 65 per cent increase in the average cost of commodities since that year."

[3] The American Standards Association finds that the cheapest make of cars have a cost running "as low as 19 cents per pound for a touring car, and 26 cents for a sedan. (It is curious that with other makes of cheap cars, the two body types differ only 3 per cent to 10 per cent in prices per pound). On the high priced cars the price runs up from about 70 cents to one dollar or more, while the middle class of cars in mass production is priced between 37 cents and 50 cents a pound, with touring car and sedan or coach practically identical in price per pound." *Sustaining Members Bulletin*, *op. cit.*, Nov. 5, 1927.

[4] James H. Rand, Jr., "Assuring Business Profits," New York, 1926, pp. 119–120.

[5] According to "Vossische Zeitung," Berlin, Nov. 7, 1926, Professor Gropius argued that such standardization would not lead to a scarcity of forms, but would reduce costs considerably. For example, he believed that the cost of standard single windows, as compared to non-standard types, would be 35 per cent cheaper; with double windows, 28 per cent cheaper; with doors, 39 per cent cheaper.

house built in accordance with Master House Standards has no depreciation for the first five years and only one per cent per year after that."[1] No clear-cut evidence has been adduced by the National Builders Supply Association in support of this estimate, and, of course, such a method of allocating depreciation is open to question.

The Federal Government is perhaps the outstanding purchaser of end consumption goods to employ the technique of purchase upon standard specifications. Estimates have placed total government savings, due to standardization, as high as $100,000,000 per annum.[2] The Government buys varnish for 80 cents which its makers sell to the public for $7, and cleaning fluids for from 5 cents to 12 cents per pound which are sold to the public for from 60 cents to 90 cents per pound. Numerous other examples could be cited.[3] While part of this saving is due to quantity purchasing as well as to rigid specifications, such quantity purchasing is not safe without standards. But more important is the fact that the specifications eliminate trade and brand names, concentrate upon the essential characteristics of the desired materials, eliminate adulteration with non-essential and inert materials, etc.

State governments and municipalities, as has been pointed out before,[4] have in numerous instances interested themselves in purchase specifications. Important savings have been made, and important savings can be still made by this method.[5] Aside from governmental organizations, the Association of American Colleges has perhaps had the most interesting experiences along this line. The system of pool buying which the Association set up employs laboratory research standards and specifications. "The experiment was inter-

[1] "The Safeguard Policy," issued by the Master House Department of the National Builders Supply Association of the United States of America, New York.

[2] American Standards Association, in letter to Cotton Textile Institute, files of the American Standards Association, June 22, 1927.

[3] F. J. Schlink and Robert A. Brady, "Standards and Specifications from the Standpoint of the Ultimate Consumer," *Annals*, *op. cit.*, May, 1928. See also, Chase and Schlink, *op. cit.*

[4] Chap. VIII of this volume.

[5] *The Philadelphia Public Ledger*, Aug. 13, 1928, quotes an estimate that standard construction maintenance and operation would save American municipalities $300,000,000 a year.

rupted by the war but a final survey showed that we had made purchases for 86 colleges in 26 states, had reduced average unit costs 38 per cent, and that the amount saved was at the rate of a little over $100 for each hour of service rendered."[1] In some cases, the savings effected were astounding.[2]

It might be argued that any saving that is realized by business must of necessity be passed on to the consumer. There are, of course, several valid objections to any such contention. Trade and brand monopolies, price agreements, resale price maintenance may more or less lift commodities out of price competition. Even if, in the long run, these break down, there is the important fact that any such "long run" means a considerable time lag in passing on the saving. Wherever goods are manufactured according to known specifications, and so advertised to consumers, there is less reason for supposing that these retarding factors may more or less indefinitely postpone the realization of these savings on the part of the ultimate consumer.

Standardization results in savings to consumers not only through lowered original cost but also through lowered maintenance charges. The improved Mazda lamp is not only cheaper, but it uses much less current for the light furnished. The standardization of voltage has likewise considerably

[1] John C. Dinsmore, in address to the National Coal Association, June 9, 1926, files of the American Standards Association.

[2] John C. Dinsmore, "Purchasing, Principle and Practice," New York, 1922, p. 263, cites a few specific examples:

(1) "Seven years ago we found that by changing the specifications on tennis nets, the life of the nets would be doubled, and the cost reduced from $36 a dozen to $16.50 a dozen.

(2) "For six years two office buildings used a disinfecting spray costing $1.25 per gallon or $62.50 per barrel. Upon analysis it proved to be formaline, perfume, and Lake Michigan water, costing the dealers 47 cents per barrel.

(3) "Another janitor supply costing $1.25 per gallon could be produced for $2 per barrel.

(4) " . . . some institutions . . . are today buying liquid soap for a dollar or more per gallon, while the Y.M.C.A. College makes a better soap for 11 cents per gallon.

(5) "Boiler compound is variously priced from 7½ cents to 35 cents per gallon and is used in Chicago in huge quantities. But the Bureau of Standards experts report that no compound is needed for Chicago water.

(6) "Within the last few months I have seen requisitions for an expensive cleaning fluid which analyzed 92 per cent water and 3 per cent silica—or sand.

(7) "Sweeping compound is a large item of expense in many institutions, but sawdust and water will do the job as well at a fraction of the cost."

prolonged the average life and increased the efficiency of the bulbs.[1] Standardization of ice boxes involves the use of better insulating materials, cutting down ice meltage. It is expected that such economy will result in the use of ice the year around, thus increasing the total consumption and total profits of the ice industry. Standard repair parts for appliances of all sorts make servicing not only easier, but also much cheaper.[2]

Indirect Savings to Consumers

From the point of view of the individual citizen, any saving made by a charitable organization or any governmental body is an indirect saving to himself to the extent to which, directly or indirectly, he contributes to its maintenance in the form of taxes or voluntary gifts, or to the extent to which he benefits from its activities. But there are many indirect savings that may be more important to him than these.

The attempts to standardize safety measures of moment to the individual citizen, whether fostered by the government or by private agencies, may only in a secondary sense have a money value for the average citizen. But in the long run they are of great significance to him. A very famous case is often cited in this connection. A great fire broke out in Baltimore in 1904. Equipment sent to aid the Baltimore fire forces from Washington, Philadelphia and New York was unable to couple to hydrants and hose and was consequently, absolutely useless in the emergency. Boston had a similar experience in 1872. The result was that a concerted program for the standardization of fire hose and fire hose couplings was launched. In the great Fall River fire in 1927, because of standardization of sizes and threads of fire hose couplings and hydrants, "37 pieces of fire apparatus from 24 cities responded to the emergency call and were able to hook up effectively with standard threads and couplings,

[1] Schlink and Brady, *op. cit.*

[2] "Standardized parts and standardized labor charges for 304 different operations that cover every service job possible on a Chevrolet assure those needing service on their cars, work that they can depend upon. Also and what is equally important, they know in advance what the job will cost." *Wilkes-Barre Times*, July 5, 1928.

and bring practical assistance in saving Fall River from more extensive damage."[1]

The American Standards Association has under way a Safety Code for Walkway Surfaces.[2] This deals with walkway surfaces for halls, floors, stairs, streets, etc. The slipping hazard with some walkways under certain weather conditions is very great. Another project dealing with school lighting led to the publication of a bulletin, "School Lighting as a Factor in Saving Sight," which was widely circulated to "all state, county and city superintendents of education, presidents of teachers colleges and normal training schools, directors of kindergarten training libraries (public, medical and business), state health officers, civic, health and welfare organizations and central lighting stations."[3] The Society of Automotive Engineers has established standards "for passenger-car bumpers, bumpers for small motorcoaches and light delivery trucks."[4] Standard height bumpers will eliminate one of the most frequent causes for automobile accidents, failure of bumpers to protect the car and locking of bumpers.

Standard safety codes and safety measures worked out by private or quasi-public organizations are on occasions made the basis for safety legislation. In 1926, the City of Baltimore "adopted an ordinance prohibiting the sale of gas appliances and tubing that do not meet with the specifications of the American Gas Association." In order to accomplish this end, "all Baltimore firms that sell gas appliances must be registered with the commissioner of health."[5] States and municipalities in the United States are being urged to adopt a model municipal traffic ordinance, drawn up by the National Conference on Street and Highway Safety. This code covers "uniform speed limits, traffic signals, right of way rules—in fact, everything pertaining to traffic except a uniform traffic cop's lexicon."[6] When it is remembered that there are now about 25,000,000 motor vehicles in use in the United States and that about 85 per cent of the country's annual traffic toll of some 25,000 deaths and 700,000 personal injuries are due to automobile accidents, and that a con-

[1] *Sustaining Members Bulletin*, *op. cit.*, May 22, 1928.

[2] *Ibid.*, May 20, 1926. This project is not yet completed.

[3] *Ibid.*, June 30, 1925.

[4] *Monthly News Bulletin*, *op. cit.*, Dec. 15, 1927.

[5] *Gas Progress*, April 1, 1926.

[6] *The Washington Star*, Aug. 1, 1928.

siderable number of these are due to lack of information or to misunderstanding regarding traffic rules and regulations, the importance of this code as a safety measure is very great.

There is the additional fact that such a code in practice would eliminate one of the greatest annoyances in driving—variance in traffic rules. Traffic rules where no traffic policemen are needed; indistinctly marked "one-way" streets; rules for crossing arterial highways; rules for right and left turns; speed limits in town and out; parking regulations; rules defining the right of way of pedestrians; rules about locking cars and other pertinent matters incident to ownership and use of cars, vary so much from city to city and state to state that the most conscientious driver continuously breaks laws without realizing the character of his offenses.

To the ultimate consumer and the average citizen, the negative value of standardization is sometimes its most important feature. A German firm advertises standard paper sizes, which it produces, with a small booklet showing an ordinary penholder with ten different pen points arranged around it and bearing the following legend: "What would you say if you had to have ten different penholders for these ten pens?" On the inside of the leaflet appears, "Why do you not object when you have to use different envelopes for five different enclosures because the page sizes are not the same? They could just as well go in the same envelope and would be cheaper and more practical. Pens are standardized and fit in their holders; page sizes are also standardized and fit in their holders, only you do not know it, or you would long since have taken advantage of this standardization."[1]

The factor of convenience is not the least of the reasons why the subway and street car systems standardize their methods of collecting fares, why income tax forms, checks, notes and drafts are as highly standardized as they are. Non-standardization of electric plugs and sockets has been one of the most common sources of annoyance to the consumer in the past.[2] One of the most important reasons why American

[1] *Sustaining Members Bulletin*, *op. cit.*, May 10, 1927.

[2] Non-standard frequencies and voltages have been largely instrumental in preventing the wide use of electric appliances in London, England. See, C. E. Skinner, "The Present Status of Standards in the Electrical Industry," *Annals*, *op. cit.*, May, 1928, pp. 151–156.

automobiles have a world-wide market and why foreign automobile manufacturers have been unable to compete with them successfully is the ease with which standard repair parts can be found for American cars.[1] Several years ago it was found that one of the most important reasons for the lack of popularity of motion pictures among large classes of people was the many stoppages and imperfections in films due to irregular and non-standard film perforations, perforation spacings, motion picture machinery and methods of handling film and machinery. Standards have completely eliminated these difficulties.[2]

Summary of Present Status

In many cases where standardization has been applied to end consumption goods, the results have already proved their worth to the consumer in direct savings in original cost and maintenance, or indirectly through increased safety and greater convenience. If one were to compare the amount of standardization work in the field of producers' goods and services to the range of goods to be found in the catalog of a large mail-order house, it would seem that the work has hardly begun. In some fashion or other, practically all consumers' goods are subject to the technique of standardization. It may be that the consumer gains ultimately in all cases, whether the standardization take place in consumers' or producers' goods and services, although the case can not be considered proved. Several factors may intervene to postpone the passing-on of these savings to the consumer. Certain types of standardization, such as safety codes and interchangeable repair parts, are of immediate advantage to the consumer whether or not they save money. It may be confidently expected that standardization will, as time goes on, be extended to include ever larger groups of consumers' goods and services and that, barring unforeseen and uncontrollable market forces, large benefits will accrue to the consumer sooner or later.

[1] A Swedish motorboat manufacturer has taken advantage of the fact that Ford parts are standard, cheap and easily procured, by building motorboats using such parts. *Sustaining Members Bulletin*, *op. cit.*, Mar. 12, 1926.

[2] Donald J. Bell, "Motion Picture Film Perforation," *Transactions of the Society of Motion Picture Engineers*, Oct. 2–3, 1916.

CHAPTER XVI

THE TREND OF INDUSTRIAL STANDARDIZATION

IN GERMANY the term "rationalization" has been coined to include the whole concert of efforts to eliminate economic waste in production, distribution and consumption processes. The term is highly expressive of the characteristics of these efforts, whether one considers the problem of the reclamation of chemical riches from the scrap-heap or the standardization of envelopes and bank-checks; simple time and motion studies or scientific research in the Bell Telephone Laboratories. In every case the systematic is replacing the haphazard, the definite is replacing the casual, scientific precision is replacing the rule-of-thumb, the "rational" and the scientific are replacing the irrational and the unscientific.

In all these efforts to eliminate industrial waste, standardization occupies an important and strategic position. Without standardization, mass production is impossible. To mechanize, to use machines, is to standardize, whether one realizes it or not. The growth of the machine industry and the growth of technological information have increased the dependence of industrial processes upon scientific research. They have, therefore, necessitated an ever closer relationship between standardization and scientific research, just as the growth of scientific information has necessitated the standardization of research techniques. The Bell Telephone System has, at once, the most highly integrated, intimately coordinated, and thoroughly standardized industrial mechanism and the largest and best-equipped industrial laboratory in the world.

The Growth of Standardization

The full value of standardization as a tool has received belated recognition from industry as a whole. For reasons that have been briefly outlined before,[1] comparatively little

[1] See Chap. I of this volume.

attention was given to industrial standardization up to the time of the World War. While there are some notable exceptions to this generalization, such as in the railroad, telephone, telegraph and the growing automobile industry, the World War and the post-war depression brought into sharp relief, for the first time, the full business significance of industrial standardization. The successful prosecution of the War demanded conservation of resources and rapid mass production. This meant the elimination of sizes, shapes and varieties, and the systematization, integration and coordination of purchasing, processing and distributing operations. The post-war depression offered business men an opportunity and an added incentive to apply the lessons learned during the War. The points of view of the business executive, the engineer and the technician began to converge, as never before, on the question how to cut costs to the minimum without decreasing production, or how to increase production and keep costs down. Standardization offered one of the important keys to the problem.

Because of the characteristics of modern economic processes, which stress more and more industrial and geographic interdependence, the situation that affected one affected nearly all industries in all countries alike. In every important industrial country, standardization became almost over night a highly prized tool. Where there was but one national standardizing body before the War—the British Engineering Standards Association—there are now twenty such bodies. Where but a few scattered firms had standard departments before that time, the number now is rapidly approaching the one hundred mark in the United States alone. Where standardized practices were formerly the business of the individual department, standardization now occupies, in more and more firms, the position of a settled corporation policy. Where an occasional trade association gave part of its time and money to developing association standards before the War, there are now some 300 trade associations in the United States alone that have accepted standardization, in some form or other, as a settled and fairly well defined policy.

These associations have become so important that to a

large extent they dominate the entire standardization movement. Where former technical standards were almost exclusively the product of the deliberations of the various engineering societies, engineers are now largely called upon to devise and draft standards for projects that are initiated, promoted and carried through under the auspices of private companies and trade associations. It is this fact that largely accounts for the recent reorganization of the American Engineering Standards Committee, the proposed reorganization of the British Engineering Standards Association, and the reorganization in 1926 of the Deutscher Normenausschuss. It is also this fact that is responsible for the establishment of the Division of Simplified Practice, the Commercial Standards Unit and the Specification Unit of the Federal Government,[1] and for similar movements in Australia and, more recently, in Great Britain. At the same time, this dominance of trade associations has been responsible, in large part, for the reorganization of the work of the engineering societies. The Society of Automotive Engineers, the (quasi-engineering) American Society for Testing Materials, the American Railway Engineering Association, the American Society of Refrigerating Engineers and several others have established very close relationships with one or more of the larger trade associations, and in some cases (such as the American Railway Engineering Association) act as the engineering branch of the association.

These trade associations and private companies interested in industrial standardization include producers, distributors and intermediate consumers. More recently they have come to include organizations representative, in a broad way, of ultimate consumers. At the same time, the movement has proceeded in all branches. Standardization of nomenclature has gone on, sometimes as a prerequisite and sometimes as an incident to standardization of dimensions. Standard purchase specifications have standardized qualities at the same time that standard processes have necessitated

[1] It should be remembered that, with perhaps minor exceptions, the standardization work of the Commercial Standards Group does not represent any attempt on the part of the Government to dictate to business. They provide *forums* and *machinery* for the initiation, development and promotion of standards by industry itself.

standard safety devices, standard ratings of machinery and simplification of product.

The Complexity of Standards

The tremendous post-war mushroom growth of the standardization movement has given rise to a multiplicity of standards of all shapes, types and descriptions. Private firms, trade associations, engineering societies, "single-purpose" national standards bodies, government groups—state, municipal and federal—have been engaged in drafting, recommending or promoting standards. The result has been a considerable duplication of efforts, a profusion of standards on the same subject and with reference to the same details, much working at cross purposes and no small amount of misunderstanding. So significant has this fact become that there has arisen a concerted movement for the "standardization of standards."[1]

The shift in the balance of power from the technical societies to the trade associations and corporations has served to emphasize this need for cooperative effort in the development of standards. The technical features of standards call for the cooperation of the technician, the engineer and the scientist. Purchase specifications call for the cooperation of buyer and seller. Standard production processes call for the cooperation of management, technical staff and labor. Standard products call for the cooperation of manufacturer, distributor and consumer. As industrial operations become more intimately related and consequently more interdependent, any change in industry or industrial operation spreads more widely throughout the system, the effects become more vital, the community of interest wider, and the need for cooperation between all parties concerned greater.[2]

[1] *Electrical World*, "Professional Societies and Standardization," April 16, 1927, p. 796: "According to available information there are engaged in standardization work in this country 48 states, 60 cities, 203 technical societies and trade associations, 54 government bureaus or boards and 6 or 8 general agencies. And new organizations or agencies are clamoring to get into the game. These bodies spent about $8,000,000 last year in standardization work."

[2] An excellent illustration of the extent to which standardization in one industry affects other industries is found in the following example from war experience published in *The Literary Digest*, July 19, 1926: "Pneumatic tires, reduced from 232 styles to 9; solid rubber tires, 100 styles to 15; steel pins, 700 to 300; china and

Many standards, of course, are designed to meet the peculiar needs of a particular industry. But standardization significant to more than one industry can best be forwarded through a national or international clearing house. It was recognition of this fact that led to the formation of the national standards bodies and of the different units in the Commercial Standards Group. But with the growth of the movement, even these organizations have been forced to make changes.

The old American Engineering Standards Committee suffered from several defects. In the first place, it was hampered by lack of funds and did not have the support of large sections of the business public. In the second place, the balance of power was left in the hands of a group whose relative importance in the standardization movement was steadily waning—the engineering group. In the third place, there was no very definite and clear understanding among business executives at large of the character of its work. In the fourth place, there was an apparent conflict of jurisdiction between the Committee and the Commercial Standards Unit. Finally, its machinery was cumbersome, largely because of insistence of its member bodies on organization prestige. This made it very difficult to expedite even those projects upon which there was little disagreement.

It is hoped that the reorganization will have corrected these major defects. Arrangements are being made to further a situation whereby the Federal Specifications will be submitted gradually to the American Standards Association for approval as American Standards, and whereby no project falling under the jurisdiction of the Association will be undertaken by the Commercial Standards Unit. There are still many points in regard to the relative functions of the Standards Association and the American Society for Testing Materials that are not clear and cause confusion.

Logic would seem to require that the first step in standardization in every case should be in the factory where stan-

crockery from 695 pieces to 330; 5,500 styles of rubber footwear discontinued, meaning a yearly saving as follows: 29,012,600 cartons, 5,245,300 square feet of lumber, 4,795 tons of freight, 1,526,423 cu. ft. shipping and storage space, 2,250,272 lbs. of material that will not have to be dyed, 74,750 lbs. of flour and starch, 30,380 gallons of varnish, 125,300 lbs. of tissue paper, 49,617 days of labor."

dards can be tried out in practice.[1] The next step would be to try them out in an entire industry, and finally to have them established on a national basis. But just as there is considerable duplication of effort all along the line within national boundaries, so is there considerable working at cross purposes in the different national standardizing bodies. International and regional standards are gradually meeting this situation. In Europe, cooperative effort between the national standards bodies is steadily eliminating duplication of effort. German standards are in particularly wide use, and in the formation of new standards the German standards body is cooperating actively with those in other countries. Similar cooperation is found between the different standards bodies within the British Empire, and between the American Standards Association and the Canadian Engineering Standards Association. Scientific standards are largely international in scope. The International Standards Association was organized for the purpose of facilitating the exchange of standards by the different national standards bodies.

Obstacles to the Development of Industrial Standards

Wherever extensively exploited trade or brand names or patent rights are involved, standardization has made little headway. The object of trade and brand names is to build up good-will and lift goods out of competition. The object of standards and specifications is primarily to eliminate superficial differences and to center attention on price. Manufacturers do not want to sacrifice a trade advantage based upon good-will secured through the popularization of a trade or a brand name by admitting that their product is made according to a specification followed by the entire trade.

On the other hand, manufacture according to known specifications is frequently a means of securing a market for those firms whose trade or brand names are not widely

[1] In all cases and in all stages of the development of standards, it is taken for granted that the interests of consumers, intermediate or ultimate, should be safeguarded by formal or informal representation.

known. If such firms succeed in cutting in on the market of the branded goods, then the manufacturer of the branded goods may be forced, in self defense, to advertise the fact that his goods meet the same requirements or that they are above those minimum requirements by a certain amount. So that even where brand competition exists, specifications and standards may come to have considerable commercial utility.

Another obstacle to standardization is the fear that standards of certain sorts, particularly dimensional standards emphasizing interchangeability of parts for an assembled piece of machinery or equipment, may result in the partial or total loss of business to other manufacturers. This might, in the first place, cause a loss in total revenue through a loss in the parts manufacturing business. In the second place, ill-fitting or sub-standard quality parts might injure the reputation of the maker of the equipment rather than the maker of the parts, because of the inability or the unwillingness of the user to discriminate between the two. Then, again, where the manufacturer has produced a commodity according to his own standard over a long period of time, he may feel that he has more to gain from following this standard than by agreeing to cooperate with other manufacturers in the establishment of a common standard. Particularly is he apt to feel this way if the equipment produced has a long potential usefulness and if the firm has a well-established reputation in the field. He may think that any change would adversely affect that reputation, however wise the change might in itself seem to be.[1]

While these may be valid enough reasons for opposing standardization from the point of view of the manufacturer, the user may see the matter from quite a different

[1] An attempt to standardize diameter and pitch of threads on surveying transits and tripods met with the objections:

"1. Some felt that the customers wished the change, while others felt that they did not wish it.

"2. There seemed to be the danger of the manufacturer's reputation being damaged by an ill-fitting tripod.

"3. The manufacture of tripods might gravitate to a foreign industry, might not be made so well and there might be a loss of revenue on this item to the manufacturers." Division of Simplified Practice, Minutes of the 2nd Meeting, April, 1927, files, American Standards Association.

angle.[1] The consumer, intermediate or ultimate, is presumably interested in good quality and low prices, and in the long run it may pay to cater to the consumer interest rather than to oppose it. But whether or not this is the situation in all such cases, these objections are not raised to standards as such, but to *a particular* standard. The question is not standardization as contrasted with no standardization, but a particular standard as contrasted to several particular and individual standards. Where this is the case, the general standard must rest on its own merits.

Where an industry caters to a demand highly influenced by changes in custom, standardization has made little headway. It does not follow, however, that standards of some sort might not be valuable in these industries, nor that the introduction of standards is always opposed.[2] Even where the industry is largely on a custom-made basis, nomenclature and materials may be standardized. Some of the most expensive luxury objects, such as radio-phonograph sets and the better makes of automobiles, are most highly standardized, even with respect to the principal style factor —as, for instance, body design of automobiles. Sizes, nomenclature, fiber content, thread count, type of weave and dyes used in the most fashionable and most seasonal women's clothes can be standardized. Without some degree of standardization, comparisons are almost impossible. Examination will show that a considerable degree of standardization has more or less unconsciously asserted itself even in these fields.

All of which would argue that the principal obstacle to

[1] N. E. Grover, Chief Hydraulic Engineer of the U. S. Dept. of Interior, Geological Survey, in commenting on the attempt to standardize screw threads on transits and tripods, states that "We have in the failure of this project another illustration of the conflict of private gain with service to the public. In the long run the interests of the public in a great industrial country like the United States will surely prevail."—Letter to F. J. Schlink, July 15, 1927, files, American Standards Association.

[2] "The labor-time figures seem to show that considerable labor-saving machinery and improved methods have been introduced into the (boot and shoe) industry in the last quarter century, and that the best practice of 1925 should be more than double the best performance of the nineties; but the productivity data for the industry as a whole can be interpreted as showing that the increased labor productivity under mass production has been about counterbalanced by the growth in the demand for specialty and novelty shoes. The production of boots and shoes is still a small-scale industry for the most part. . . .," U. S. Bureau of Labor Statistics, *Monthly Labor Review*, October, 1926, p. 11.

standardization is ignorance concerning the meaning and the uses of standardization. There may be a point, in certain fields, beyond which standardization can not proceed without bringing into existence a "dead-level of uniformity." But up to that point, especially where machine production methods dominate manufacture or fabrication, diversity is meaningless and highly expensive. Men's clothing and a considerable percentage of the female ensemble have been quite successfully standardized. The Knox Hat Company has standardized hats and the Regal Shoe Company has standardized shoes. German straw hat manufacturers have standardized men's straw hats.[1] The American Standards Association has a project under way for standardizing bed sheets and sheetings. The Federal Government has standards for nearly every conceivable producers' and consumers' commodity.

So far as trade associations are concerned, standardization has probably been held back somewhat by uncertainty of the legal status of such activity. But, as has been pointed out before,[2] in the few cases in which the matter has come up, standardization has been regarded by the courts as a perfectly legal trade association function. This does not, however, entirely dispose of the matter, since a trade association might conceivably be made a party to suit or other legal action involving a standard accepted or used by its membership. Especially is this true if trade association standards are used as a basis for legislation in such matters as safety codes for house wiring, gas appliances, walkway surfaces, etc.[3] But while this may well offer ground for hesitancy in establishing formal trade association standards, the very existence of the standard itself in such matters is a protection of the membership against the charge of careless or fraudulent work.

Within the individual plant there is sometimes a conflict between the engineering and purchasing departments due to

[1] *The New York Times*, July 25, 1926.

[2] See Chap. V of this volume.

[3] It is not intended to imply here that such action would call into question the legality of the standard, but rather that litigation might involve the trade association, in the case of departure from the standard, as an authorization or as an interested party in the adequacy of the standard as such.

difference in point of view. The point of view of the engineer may not be one that takes full cognizance of the factors of cost and price. Purchasing agents may feel that they demand properties or qualities in the materials not necessary for economical production. The engineers, on the other hand, are sometimes inclined to feel that purchasing agents buy whatever is cheap, regardless of the needs of production, and that what they purchase sometimes turns out to be very expensive in the long run. But this difference in point of view serves only to emphasize the need for cooperation of these departments. In most cases where a serious standardization program has been inaugurated by private firms, it has not been a very important obstacle, except perhaps in the early stages.

This same difference in point of view is sometimes brought out in standardization work involving the cooperation of technical or engineering societies with trade associations and individual companies. But here also the difficulty seems to be disappearing. Especially is this true in those fields in which the dominant rôle has been assumed by the trade associations.

There are numerous other obstacles to be overcome in the process of establishing standards. Like those enumerated above, some of these are based upon conflicts in jurisdiction, misunderstanding concerning the nature, uses and scope of the standards when established, conflicts in points of view, conflicts of interests, fear of legal action, and so on. Yet these types of difficulties are common to any large, new, rapidly growing movement of far-reaching industrial importance, especially one which calls for an increasing measure of cooperative effort. Temporarily, these difficulties present great, and in some cases almost insuperable, obstacles in the path of standardization. They are reflected in lack of financial support for standardization projects and standards bodies,[1] refusal to cooperate, and sometimes direct sabotage. But what material there is available on the histories of standards projects, particularly those of a national scope, shows

[1] The financial handicaps under which the standardization work of the American Standards Association has labored have been so serious at times as to cripple the effectiveness of the entire organization. A similar difficulty has been experienced abroad, particularly in the case of the British Engineering Standards Association.

an increasing degree of cooperation and offers ground for justifying the expectation that in the future these obstacles will diminish in importance.

Standardization and Progress

Standardization should be regarded as a tool, a method, a device or a technique for achieving certain ends. As has been remarked, "standardization is a useful servant, but a bad master."[1] It depends entirely upon what use is made of standardization whether advantages outweigh disadvantages, whether standards promote or retard industrial and cultural progress.

There are, of course, no such things as advantages or disadvantages of standardization in the abstract. In a broad way, judgment as to particular standards projects, or as to standardization in general, must rest upon a satisfactory answer to these three questions:

> (1) Does standardization have the effect of forwarding technical and scientific improvement of processes, techniques, and equipment that possess industrial significance?
>
> (2) Does standardization make possible a higher average standard of living?
>
> (3) Does standardization act as "the liberator that relegates the problems that have been already solved to their proper place, namely to the field of routine, and leave the creative faculties free for the problems that are still unsolved . . . (acting thus as) . . . an indispensable ally of the creative genius?"

Since improvement in mechanical technique and mechanical equipment, higher standards of living, and creative effort and individuality are considered highly desirable ends in modern times, an affirmative answer to these three questions establishes standardization as a force promoting progress.

It should be remembered, in the first place, that our concern here is with standards arrived at by conscious, deliberate, selective process, and that the only basis for judging the effect of these standards must of necessity be what we know about standardization as practised to date. And, in the second place, it will not do to argue from the particular

[1] Norman F. Harriman, "Standards and Standardization," New York, 1928, p. 19.

to the general, unless it can be independently established that the particular is in some broad and significant respect typical of the general.

With these mental reservations available evidence emphatically supports an affirmative answer to the three questions. In support of this conclusion that standardization has effectively forwarded technological, economic, social and cultural progress, it may be well to summarize briefly the evidence in answer to each of the three questions.

Technical Progress

It has already been observed that the private companies—such as the Bell Telephone System, the General Electric Company, the Westinghouse Electric and Manufacturing Company, the Detroit Edison Company, the United States Steel Corporation, the Firestone Tire and Rubber Company, the General Motors Corporation; the trade associations—such as the American Gas Association, the National Electric Light Association, the National Electric Manufacturers Association; and the technical societies—such as the American Institute of Electrical Engineers, the American Society of Mechanical Engineers, and the American Society of Automotive Engineers—that are most active in the field of standardization, are precisely those companies, associations and societies, that maintain the best scientific and industrial laboratories or cooperate in scientific work with the Bureau of Standards or other large laboratories in the most effective and thorough fashion. This fact in itself lends strong empirical evidence to the conclusion that standardization, technical improvement and scientific research are not mutually exclusive, but highly complementary industrial activities.[1]

That the danger exists that standardization may, if rigidly adhered to over a long period of time, "tend to stereotype existing methods and designs" is a foregone conclusion.

[1] For example, the railway track-gage is narrower than technical efficiency or economical operation would justify at the present time, were the railroads to be built over again. This is sometimes used as justification for the theory that standardization of necessity stultifies technical improvement. Yet the case of the railway track-gage is one in which change is inhibited by the fact that the cost of the change to the more technically efficient gage would far outweigh the advantage of the wider gage, and is hence no different from any case, involving standardization or not, in which the costs of alterations are so proportionately high.

Therefore it is necessary carefully to check up on existing standards and methods.[1] The larger companies have been remarkably successful in this task of keeping standards in step with the latest improvements. In order to avoid any stereotyping effect, it is imperative that standardization projects be not too hastily pushed to completion. On the other hand, it is imperative that machinery for constant and expeditious revision be provided. One of the principal criticisms that have been made of the Commercial Standards Unit is that since its formation in January, 1928, it has pushed new standards projects so rapidly that all the necessary factors and interested parties have not, or can not be taken into consideration. The opposite criticism was made of the old American Engineering Standards Committee.

But the fact that these dangers exist serves, in light of the accomplishments to date, only as a high tribute to the skill and wisdom with which standardization work has been conducted, and if in the future it runs true to the forms it has taken up to the present, there seems no ground for believing that standards will result in industrial stereotypes.[2]

The Standard of Living

The high standard of living in the United States is a matter of common knowledge. But the United States has also the most highly standardized industrial system in the world.

[1] "Standardization in the Bell System is more than a means of obtaining economy and efficiency. It is essential to the most rapid progress. . . . Standardization is . . . not a static thing but is dynamic, involving a continuous procession of new standards to meet new conditions or to meet old conditions better than was heretofore possible, and the consequent dropping of old standards." "Standardization in the Bell System," *op. cit.*, p. 2.

"After the various committees have completed their work of simplification and standards have been set up for the guidance of engineers and others within the company, the problem of making these standards effective presents itself. This should not be misconstrued as an effort rigidly to limit the choice of materials and equipment to those contained in the approved standards lists, as such policy would, to a large extent, preclude the use of new and improved designs and types." The Detroit Edison Company, "Standardization," unpublished, pp. 4–5.

"In all instances where standardization has been successful, it had to be done on two main premises. Standards must be flexible and adapt themselves to changing basic conditions of the industry. They must therefore be subject to revision on account of continuous modifications in engineering research." "Standardization Problems of the Westinghouse Electric and Manufacturing Company," unpublished, p. 8.

[2] "Standardization can not take away incentive, because standardization is not invention in any way." E. C. Peck, *The Cleveland Times and Commercial*, Dec. 12, 1924.

And within the United States, those individual firms that have carried through the most complete and thorough standardization programs are precisely the firms that cater to the largest markets. While this fact, in and of itself, does not establish definitely the contention of a direct causal relationship, it does lend evidence in support of the contention that the high per-man-hour productivity in the United States and the comparatively high purchasing power of the daily wage and of the average annual income are due, at least in large part, to more highly mechanized processes of production, in which standardization has come to be an indispensable element.

There is, of course, the fact to be faced that cheapened production processes, in which standardization has taken and is taking an important part, have shifted the major industrial problem away from production and towards marketing, with the net effect that the ratio of marketing to production costs is steadily increasing; that is to say, standardization has helped to create a situation that in part offsets the advantage of standardization itself. Yet the answer here may lie in simplifying and systematizing market techniques. One of the major causes of high marketing costs is duplication of services and facilities. To the extent that simplification of the channels of distribution may eliminate this duplication, standardization can be used to raise still further the purchasing power of the daily wage.

At any rate, the standard of living seems to be steadily mounting. In no other place in the world is the consumption of such goods as radios, automobiles, electric and gas appliances, phonographs, newspapers, magazines, books, bath tubs, typewriters and consumption goods in general so high per capita as in the United States. Most of these goods are as highly standardized as they are cheap.

Cultural Progress

There is no agreement as to the character of the conditions that foster high types of cultural achievement. Some believe that physical comforts kill imagination, take away the incentives for achievement in the arts and sciences, and generally stultify intellectual endeavor. On the other hand,

the contention is made that the greatest evil of all is poverty and that without good and cheap material, necessary for a high standard of living, culture can not flourish.

Historically there has never been a culture rich in achievements in the arts and sciences without a leisure class. The Egypt that built the great temples at Karnak, the Persia of Darius, the India of Asoka, the Athens of the time of Pericles, the Rome of Petronius, the Florence of the time of the Medici, France of the sixteenth century and Mid-Victorian England were highly rated for their cultural achievements, but all belong to eras in which members of a large leisure class were able to turn their time and energies away from the task of gaining an economic subsistence. If the machine industry is able to democratize leisure, it may be opening up the way for the greatest cultural renaissance in the history of the world.

APPENDICES

APPENDIX A

SPECIFICATIONS FOR MATERIALS[1]

"(1) A specification for material should contain the fewest possible restrictions consistent with obtaining the material desired.

"(2) The service which the material is to perform, in connection with reasonably feasible possibilities in its manufacture, should determine the limitations of a specification.

"(3) All parties whose interests are affected by a specification should have a voice in its preparation.

"(4) The one who finally puts the wording of the specification into shape should avoid making it a place to show how much he knows, as well as a mental attitude of favor or antagonism to any of the parties affected by it.

"(5) Excessively severe limitations in a specification are suicidal. They lead to constant demands for concessions, which must be made if work is to be kept going, or to more or less successful efforts at evasion. Better a few moderate requirements rigidly enforced, than a mass of excessive limitations which are difficult of enforcement, and which lead to constant friction and sometimes deception.

"(6) There is no real reason why a specification should not contain limitations derived from any source of knowledge. If the limitations shown by physical test are sufficient to define the necessary qualities of the material, and this test is simplest and easiest made, the specification may reasonably be confined to this. If a chemical analysis or a microscopic examination, or a statement of the method of manufacture, or information from all four, or even other sources, are found useful or valuable in defining limitations, or in deciding upon the quality of material furnished, there is no legitimate reason why such information should not appear in the specifications. Neither the producer nor the consumer has a right to arrogate to himself the exclusive right to use information from any source.

"(7) Proprietary articles and commercial products made by processes under the control of the manufacturer can not, from the nature of the case, be made the subject of specifications. The very idea of a specification involves the existence of a mass of common knowledge in regard to any material, which knowledge is more or less available to both producer and consumer. If the manufacturer or producer has opportunities which are not available to the consumer, of knowing how the variation of certain constituents in his product will affect that product during manufacture, so also does the consumer, if he is philosophic and is a student, have

[1] Dr. Charles B. Dudley, "The Making of Specifications for Materials," presidential address, delivered before the American Society for Testing Materials in 1903, and reprinted in "The Life and Work of Charles B. Dudley," New York, 1927.

opportunities not available to the producer, of knowing how the same variation of constituents in the product will affect that product in service, and it is only by the two working together, and combining the special knowledge which each has, that a really valuable specification can be made.

"(8) A complete workable specification should contain the information needed by all those who must necessarily use it in obtaining the material desired. On railroads this may involve the purchasing agent, the manufacturer, the inspector, the engineer of tests, the chemist, and those who use the material. A general specification may be limited to describing the properties of the material, the method of sampling, the amount covered by one sample, and such description of the tests as will prevent doubt or ambiguity.

"(9) Where methods of testing or analysis or inspection are well known and understood, it is sufficient if the specification simply refers to them. Where new or unusual tests are required, or where different well-known methods give different results, it is essential to embody in the specification sufficient description to prevent doubt or ambiguity.

"(10) The sample for test representing a shipment of material should always be taken at random by a representative of the consumer.

"(11) The amount of material represented by one sample can best be decided by the nature of the material, its importance, and its probable uniformity, as affected by its method of manufacture. No universal rule can be given.

"(12) The purchaser has a right to assume that every bit of the material making up a shipment meets the requirements of the specification, since this is what he contracted for and expects to pay for. It should make very little difference, therefore, what part of the shipment the sample comes from, or how it is taken. Average samples made up of a number of sub-samples are only excusable when the limits of the specification are so narrow that they do not cover the ordinary irregularities of good practice in manufacture.

"(13) Retests of material that has once failed should only be asked for under extraordinary conditions, and should be granted even more rarely than they are asked for, errors in the tests of course excepted.

"(14) Simple fairness requires that when it is desired that material once fairly rejected should nevertheless be used, some concession in price should be made. On the other hand, where a consumer buys material on specifications, it is equally unfair that he should ask from the producer any guarantees covering the behavior of the material in service. Furthermore, it almost goes without saying that where materials are for use in places involving the safety of life and property, rejected material should never be used.

"(15) Where commercial transactions are between honorable people, there is no real necessity of marking rejected material to prevent its being offered a second time. If it has failed once, it will probably fail a second time, and if return freight is rigidly collected on return shipments, the risk of loss is greater than most shippers will care to incur. Moreover, it is so easy for the consumer to put an inconspicuous private mark on

rejected material, that it is believed few will care to incur the probable loss of business that will result from the detection of an effort to dispose of a rejected shipment by offering it a second time. In this connection it may be said that those sub-employees of producers who pride themselves on working off rejected material on consumers may in reality be doing their employers a very serious injury.

"(16) All specifications in actual practical daily use need revision from time to time, as new information is obtained, due to progress in knowledge, changes in methods of manufacture, and changes in the use of materials. A new specification, that is, one for a material which has hitherto been bought on the reputation of the makers and without any examination as to quality, will be fortunate if it does not require revision in from six to ten months after it is first issued.

"(17) In the enforcement of specifications it is undoubtedly a breach of contract, legitimately leading to rejection, if the specified tests give results not wholly within the limits, and this is especially true if the limits are reasonably wide. But it must be remembered that no tests give the absolute truth, and where the results are near, but just outside of the limit, the material may actually be all right. It seems to us better, therefore, to allow a small margin from the actual published limit, equal to the probable limit of error in the method of testing employed, and allow for this margin in the original limits, when the specifications are drawn.

"(18) Many producers object to specifications on the ground that they are annoying and harassing, and really serve no good purpose. It is to be feared that the complaint is just in the cases of many unwisely drawn specifications. But it should be remembered that a good, reasonable specification, carefully worked out as the result of the combined effort of both producer and consumer, and which is rigidly enforced, is the best possible protection which the honest manufacturer can have against unfair competition.

"(19) Many consumers fear the effect of specifications on prices. Experience seems to indicate that after a specification has passed what may be called the experimental stage, and is working smoothly, prices show a strong tendency to drop below figures prevailing before the specification was issued.

"(20) A complete workable specification for material represents a very high order of work. It should combine within itself the harmonized antagonistic interests of both the producer and the consumer; it should have the fewest possible requirements consistent with securing satisfactory material; it should be so comprehensive as to leave no chance for ambiguity or doubt; and, above all, it should embody within itself the results of the latest and best studies of the properties of the material which it covers."

APPENDIX B

LIST OF MANUFACTURERS DOING ORGANIZED WORK ON STANDARDS[1]

Published Standards

1. Baldwin Locomotive Works
2. General Motors Corporation

Non-published Internal and Sometimes Confidential

3. Allis-Chalmers Manufacturing Company
4. American Laundry Machine Company
5. American Telephone and Telegraph Company
6. Browne and Sharpe Manufacturing Company
7. Burroughs Adding Machine Company
8. Carnegie Steel Company
9. Chrysler Motor Company
10. Cincinnati Milling Machine Company
11. Cleveland Twist Drill Company
12. Commonwealth Power Corporation of Michigan
13. Consolidated Machine Tool Corporation of America
14. Continental Motor Company
15. Crane Company
16. Crompton and Knowles Loom Works
17. Cutler Hammer Manufacturing Company
18. De la Vergne Machine Company
19. Detroit Edison Company
20. Dexter Folder Company
21. Edison Phonograph Company
22. Fairbanks, Morse and Company
23. Ford Motor Company
24. Gleason Works
25. Gray and Davis
26. Illinois Watch Company
27. Ingersoll-Rand Company
28. International Harvester Company
29. Johansson Inc., C. E.
30. Jones and Lamson Machine Works
31. Kimberly Clark Company
32. Link Belt Company
33. Metropolitan Life Insurance Company (as to office furniture only)
34. Montgomery Ward and Company
35. Morgan Construction Company
36. National Aniline and Chemical Company
37. National Cash Register Company
38. National Time Recording Company
39. National Twist Drill and Tool Company
40. Niles Bement Pond Company (including Pratt and Whitney)
41. Packard Motor Car Company
42. Remington Arms Company

[1] Incomplete list from files of the American Standards Association.

43. Republic Flow Meter Company
44. Royal Typewriter Company
45. Sangano Electric Company
46. Singer Manufacturing Company
47. Spicer Manufacturing Company
48. Splitdorf Electric Company
49. Stuart-Warner Speedometer Corporation
50. Studebaker Corporation
51. U. S. Gypsum Company
52. Waltham Watch Company
53. Waukesha Motor Company
54. Western Electric Company (subsidiary of American Telephone and Telegraph Company)
55. Westinghouse Electric and Manufacturing Company
56. White Dental Manufacturing Company, S. S.
57. White Motor Company
58. Wright Aeronautical Company

APPENDIX C

NATIONAL STANDARDIZING BODIES

Australia: Australian Commonwealth Engineering Standards Association

Austria: Oesterreichischer Normenausschuss für Industrie und Gewerbe.
Belgium: Association Belge de Standardisation.
Canada: Canadian Engineering Standards Association.
Czechoslovakia: Ceskoslovenská Normalisacní Spolecnost.
Denmark: Den danske Standardiseringskommission.
Finland: Finlands Standardiseringskommission.
France: Association Française de Normalisation.
Germany: Deutscher Normenausschuss.
Great Britain: British Engineering Standards Association.
Holland: Hoofdcommissie voor de Normalisatie in Nederland.
Hungary: Magyar Ipari Szabvanyosito Bizottsag.
Italy: Comitato Generale per l'Unificazione nell' Industria Meccanica.
Japan: Japanese Engineering Standards Committee.
Norway: Norges Industriforbunds Standardiseringskontor.
Poland: Polski Komitet Normalizacyjny.
Roumania: Roumanian Standards Committee.
Russia: Standards Committee, U. S. S. R.
Sweden: Svenska Industriens Standardiseringskommission.
Switzerland: Schweizerische Normalien-Vereinigung.
United States: American Standards Association.

APPENDIX D

THE DEVELOPMENT OF A TYPICAL STANDARDS PROJECT UNDER AMERICAN STANDARDS ASSOCIATION PROCEDURE[1]

Review of Development of the Work on "Bolt, Nut and Rivet Proportions"

April 15, 1920:

Proposal received from the Swiss national standardizing body to the effect that an international standard be set up on "Widths across flats of bolt heads and nuts." This proposal was also sent to England, France, Germany, Holland, Sweden and Belgium.

June 5, 1920:

The Swiss proposal was referred by the American Standards Association (then A. E. S. C.) to the American Society of Mechanical Engineers and the Society of Automotive Engineers as the bodies most competent to advise on the attitude to be taken by American industry. The suggestion was made that either a new sectional committee be formed to deal with the project or that it be referred to a sub-committee of the sectional committee on "screw threads" already in existence.

September 22, 1920:

Acceptance of joint sponsorship by the American Society of Mechanical Engineers.

December 16, 1920:

Acceptance of joint sponsorship by the Society of Automotive Engineers.

March 16, 1922:

Organization meeting of the sectional committee, where it was decided to enlarge the scope of the work so as to cover "Bolt, nut and rivet proportions."

June 5, 1923:

List of personnel of sectional committee submitted by the joint sponsors to the American Standards Association for approval.

July 23, 1923:

Special committee on personnel appointed by the American Standards Association.

September 4, 1923:

Submission of report by the special committee recommending approval of the personnel provided an engineer representing the electric

[1] Prepared by the American Standards Association.

railway track construction be added. The report also recommended that the scope be broadened to include "standardization of dimensions, material and nomenclature of all rivets, bolts, nuts and screws except wood screws, but not including standardization of thread forms."

September 13, 1923:
Report of special committee referred by Executive Committee to Main Committee.

October 11, 1923:
Approval of personnel and scope by the American Standards Association.

After the organization meeting on March 16, 1922, work had been started. By January, 1929, five standards established by the above sectional committee had been approved by the American Standards Association as follows:

B 18a–1927	Small rivets.
B 18b–1927	Wrench head bolts and nuts and wrench openings.
B 18e–1928	Round unslotted head bolts.
B 18f–1928	Plow bolts.
B 18g–1928	Tinners', Coopers' and belt rivets.

In the case of the standard on "Wrench head bolts and nuts and wrench openings," the further development was as follows:

November 17, 1925:
Publicity given to draft standard on "Wrench head bolts and nuts and wrench openings" by sending proof sheets to thirty publications located in various parts of the country.

May, 1926:
Publication of draft standard in *S. A. E. Journal* and *Mechanical Engineering* (American Society of Mechanical Engineers' publication).

August 26, 1926:
Draft standard approved by letter ballot of sectional committee.

November 11, 1926:
Draft standard submitted by sectional committee to joint sponsors.

December 6, 1926:
Formalities for approval of draft standard by joint sponsors completed.

December 31, 1926:
Submission by joint sponsors of draft standard to American Standards Association for approval.

January 4, 1927:
Special committee on approval of standard appointed by Chairman of the American Standards Association.

January 8, 1927:
Report of special committee submitted to American Standards Association recommending approval of draft standard as a Tentative American Standard.

February 3, 1927:
Standard ordered to letter ballot of Main Committee of American Standards Association with recommendation for approval as a Tentative American Standard.

February 9, 1927:
Letter ballot sent out by American Standards Association office.

February 24, 1927:
Letter ballot completed and found favorable. Standard approved.

May 16, 1927:
Copies of standard off the press.

APPENDIX E

SIMPLIFIED PRACTICE RECOMMENDATIONS[1]

PROPOSED, APPROVED AND ACCEPTED BY INDUSTRIAL GROUPS UNDER AUSPICES OF THE DIVISION OF SIMPLIFIED PRACTICE OF THE DEPARTMENT OF COMMERCE. REVISED TO AUGUST 1, 1928.

S.P.R. No.	Item	Reduction in Varieties		Per Cent Reduction
		From	To	
1	Vitrified Paving Brick (6th revision)	66	5	92
2	Beds, Springs, and Mattresses	78	4	95
*3	Metal Lath	125	24	81
4	Asphalt (1st revision)	102	10	90
5	Hotel Chinaware	700	214	69
6	Files and Rasps	1,351	475	65
7	Rough and Smooth Face Brick	75	2	97
	Common Brick	44	1	98
8	Range Boilers	130	13	90
*9	Woven Wire Fencing	552	69	87
	Woven Wire Fence Packages	2,072	138	93
10	Milk Bottles and Caps (1st revision)			
	Bottles	49	4	92
	Caps	10	1	90
11	Bed Blankets (sizes)	78	12	85
12	Hollow Building Tile (1st revision)	36	20	44
*13	Structural Slates for Plumbing and Sanitary Purposes	827	138	83
*14	Roofing Slates (descriptive terms, thicknesses and sizes)	98	48	51
15	Blackboard Slates (slab heights and sizes)	251	52	79
*16	Lumber (2nd revision)	Standard nomenclature, grades and sizes for soft-wood lumber		
17	Forged Tools (1st revision)			
	Tool Heads	665	361	46
	Eye Sizes	120	10	91
18	Builders' Hardware (1st revision)[3]			
	Items	6,948	5,130	26
	Finishes	100	29	71
*19	Asbestos Mill Board (sizes, thicknesses) (1st revision)	21	4	81
	Asbestos paper (sizes, widths, weights of rolls) (1st revision)	72	16	78

[1] National Bureau of Standards, mimeographed list, Washington, Aug. 1, 1928.

* Revised.

[3] These figures are the average reduction in catalog items in 1922 of four leading manufacturers of builders' hardware, as result of simplification.

Simplified Practice Recommendations[1]—(*Continued*)

S.P.R. No.	Item	Reduction in Varieties		Per Cent Reduction
		From	To	
*20	Steel Barrels and Drums	66	24	64
21	Brass Lavatory and Sink Traps	1,114	76	93
22	Paper[2]	..	..	..
23	Plow Bolts	1,500	840	44
24	Hospital Beds			
	Lengths	33	1	97
	Widths	34	1 standard, 2 specials	91
	Heights	44	1	98
25	Hot Water Storage Tanks	120	14	88
26	Steel Reinforcing Bars (cross-sectional areas)	32	11	66
27	Cotton Duck (1st revision)	460	86	81
*28	Sheet Steel (1st revision)	1,819	261	85
29	Eaves Trough and Conductor Pipe	21	16	24
30	Terne Plate (weights)	9	7	22
31	Loaded Shells (2nd revision)	4,076	768	81
32	Concrete Building Units (length, width and height of blocks, tile and brick)	115	14	88
33	Cafeteria and Restaurant Chinaware	700	243	65
34	Warehouse Forms	Thousands	15	..
*35	Steel Lockers	65	17	74
36	Milling Cutters	944	570	40
*37	Commercial Forms	Thousands	3	..
38	Sand Lime Brick (length, width and height)	14	3	79
39	Dining Car Chinaware	700	276	61
40	Hospital Chinaware	700	279	60
41	Insecticides and Fungicides (packages)	38	22	42
42	Paper Grocers' Bags	6,280	4,700	25
*43	Paint and Varnish Brushes	480	143	70
44	Box Board (thicknesses)	244	60	75
45	Grinding Wheels (1st revision)	715,200	254,400	64
46	Tissue Paper			
	Roll Tissue	13	3	77
	Shoe Tissue	21	6	71
47	Cut Tacks and Small Cut Nails			
	Sizes	421	182	57
	Packing Weights	423	121	71
48	Shovels, Spades and Scoops (1st revision)	5,136	2,178	57
49	Sidewalk Lights			
	Sizes	120	6	95
	Styles	80	5	94
	Shapes	10	2	80
50	Bank Checks, Notes, Drafts, etc.	Thousands	One size for each instrument	..

[1] National Bureau of Standards, mimeographed list, Washington, Aug. 1, 1928.
[2] Original total not known.
* Revised.

SIMPLIFIED PRACTICE RECOMMENDATIONS[1]—(*Continued*)

S.P.R. No.	Item	Reduction in Varieties		Per Cent Reduction
		From	To	
*51	Die Head Chasers (for self-opening and adjustable die heads)[2]	..	..	75
52	Staple Vitreous China Plumbing Fixtures	441	58	87
53	Steel Reinforcing Spirals	7	4	43
54	Sterling Silver Flatware	190	61	68
55	Tinware, Galvanized, and Japanned Ware	1,154	873	24
*56	Carbon Brushes and Brush Shunts[4]	..	..	..
57	Wrought Iron and Wrought Steel Pipe, Valves, and Pipe Fittings			
	Sizes of Valves and Fittings	20,000	19,238	4
	Sizes of Pipe	62	49	21
*58	Classification of Iron and Steel Scrap	Specificat	ion for scrap	
59	Rotary Cut Lumber Stock for Wire-bound Boxes			
	Lengths	102	6	94
	Widths	65	6	91
	Thicknesses	9	6	33
60	Packing of Carriage, Machine, and Lag Bolts[2]	..	18	..
61	White Glazed Tile and Unglazed Ceramic Mosaic[5]	..	..	..
62	Metallic Cartridges	348	256	26
63	Metal Spools (for annealing, handling and shipping wire)[2]	..	6	..
66	Brake Lining (automobile)[2]	..	37†	..
67	Roller Bearings[2]	..	172†	..
68	Flashlight Cases (metal and fiber)	25	14	44
69	Packing of Razor Blades	2 systems	reduced to 1	50
70	Salt Packages	35	19	46
72	Solid Section Steel Windows	42,877	2,244	95
73	One-piece Porcelain Insulators	272	210	23
74	Hospital and Institutional Cotton Textiles	575	26	95
75	Composition Blackboard			
	Colors	3	1	66
	Widths	18	8	55
	Lengths	90	13	86
76	Ash Handles (grades)[2]	..	..	..
77	Hickory Handles (grades)[2]	..	..	..

[1] National Bureau of Standards, mimeographed list, Washington, Aug. 1, 1928.

[2] Original total not known.

[4] Increments of increase in dimensions, and dimensional tolerances for carbon brushes, sizes of holes or slots in terminals for flexible shunts, and size and specifications for cable for brush shunts.

[5] Shapes, patterns, dimensions, grade nomenclature, grade marks, grade specifications, and certifications of grades, for white glazed tile and unglazed ceramic mosaic.

* Revised.

† Society of Automotive Engineers Standards.

RECOMMENDATIONS IN PROCESS OF ACCEPTANCE

S. P. R. No.	Item	Reduction in Varieties From	Reduction in Varieties To	Per Cent Reduction
64	Vegetable Shortening Containers...	35	11	69
65	Lead Pencils....................	..	..	..
71	Turnbuckles....................	248	115	54
78	Iron and Steel Roofing...........	..	..	..
79	Malleable Foundry Refractories...	188	15	92
80	Folding and Portable Wooden Chairs[6]...................	..	..	..
81	Binders' Board..................	718	10	98
82	Hollow Metal Doors[2].............	..	45	..
83	Kalamein Doors.[2]...............	..	36	..
84	Composition Books..............	86	41	52
85	Adhesive Plaster			
	Rolls.........................	3	2	33
	Spools			
	Widths.....................	8	5	38
	Lengths....................	23	13	43
86	Surgical Gauze (construction).....	15	7	53
87	Forms for Concrete Ribbed Floor Construction (widths)........	7	2	71
88	Floor Sweeps...................	11	6	45
89	Coated Abrasive Products........	8,000	1,976	75.3
90	Hacksaw Blades.................	..	..	75
92	Ply and Yarn Goods of Hard Fiber Cordage....................	1,304	391	70
93	Tags, Paper.....................	..	..	..
94	Fire Engines....................	..	..	..
95	Skid Platforms..................	..	..	..
96	Ice Cake Sizes..................	..	..	..

[2] Original total not known.

[6] Elimination estimated by industry as 20% in portable chairs and 19% in folding chairs.

RECOMMENDATIONS IN PROCESS OF REVISION

S.P.R. No.	Item
3	Metal Lath
9	Woven Wire Fencing
13	Structural Slate
14	Roofing Slate
16	Lumber
19	Asbestos Paper and Asbestos Millboard
20	Steel Barrels and Drums
28	Sheet Steel
30	Roofing Ternes (formerly "terneplate")
35	Steel Lockers
37	Invoice Forms
43	Paint and Varnish Brushes
51	Die Head Chasers (for self-opening and adjustable die heads)
56	Carbon Brushes and Brush Shunts
58	Classification of Iron and Steel Scrap

COMMERCIAL STANDARDS IN PROCESS OF ACCEPTANCE

Chain-Link Fence and Chain-Link Fabric.
Stoddard Solvent.
Clinical Thermometers.
Staple Porcelain Plumbing Fixtures.

APPENDIX F

PROCEDURE FOR THE ESTABLISHMENT OF RECOGNIZED SPECIFICATIONS AS "COMMERCIAL STANDARDS"[1]

"(1) Industry has long sensed the need for the wider application and use of specifications developed and approved by nationally recognized organizations. To assist these bodies and also the producers and users concerned, in securing this result, the Bureau of Standards of the Department of Commerce has formulated a general procedure under which nationally recognized specifications may be printed as official publications of the Department of Commerce and promulgated as 'Commercial Standards.'

"(2) The first step in the procedure is a specific request from some part of industry for the services of the Bureau of Standards looking toward the promulgation of a commercial standard. This service will be extended only upon specific request. Following such request, a preliminary canvass is made to determine the consensus of opinion regarding advantages and benefits of promulgating such commercial standards and probable amount of cooperation which may be expected.

"(3) If there is ample prospect of full cooperation, a preliminary conference is arranged to survey available standards or to delegate the work of making such a survey. Occasionally this survey may be unnecessary, when it it demonstrated that a given specification is so generally acceptable that it logically forms the basis for consideration as the commercial standard in its field.

"(4) In the event a survey is necessary, a committee appointed by industry obtains data on present adherence to the various standards in the field, present production and demand for various sizes and qualities, and recommends a given specification limiting grades, qualities, sizes, etc., as a tentative standard to serve as a basis for consideration at the general conference.

"(5) Acting upon the recommendations of the preliminary conference or the survey committee, agenda are prepared for a general conference of industry including producers, distributors and organized consumers. Said agenda are then referred to the proper technical division of the Bureau of Standards for review to insure compatibility with present trend or progress in the art, or with recommendations resulting from research or tests, as well as recommendations supported by various technical societies. When this review has been completed and adjustments made as circumstances

[1] National Bureau of Standards, Commercial Standards Unit, mimeographed, Washington, 1927.

warrant, the agenda are then submitted to the committee of industry for review and the authorization to call a general conference of all interests.

"(6) Following such authorization, the Bureau of Standards then forwards the agenda to all known manufacturers, distributors and organized consumers, with an invitation to attend a conference at a specific time and place, usually Washington, D. C. This general conference considers what action is feasible and desirable concerning the recommended standard, revises objectionable details, if any, and recommends adoption of the amended standard.

"(7) The Bureau of Standards then disseminates the recommendations of the general conference with requests for written acceptances from each unit of the whole industry including manufacturers, distributors and organized consumers. Upon receipt of signed acceptances representing a satisfactory majority of production, or consumption of a commodity by volume, the recommendations are published in uniform style as "Commercial Standards," and issued to all interested groups.

"(8) A certification plan is employed in connection with commercial standards by which manufacturers may certify to the consumer that their product is made in accordance with the commercial standard, thus assuring the small consumer that goods purchased will be made in accordance with the specification, without the necessity of his employing laboratory tests to prove the fact.

"(9) Provision for regular revision is made by the appointment of a standing committee to consider periodically any necessity for revision of the commercial standard in order that each may be kept constantly compatible with progress in the art.

"(10) Broadly speaking, the aim is to continue the same character of cooperative service in this field that is being rendered in simplification. The Commercial Standards Unit does not propose to act as a standardizing body nor will it engage in the preparation of specifications. The chief mission is to get behind a standard or a specification which any industry or its related groups may want to promulgate on a nation-wide basis; to determine its eligibility for promulgation; to publish and broadcast it in the event the prerequisites, including a satisfactory majority acceptance, have been met; to facilitate the application of the certification plan for the assurance and convenience of the small purchaser, and to provide a means for controlled periodical revision."

APPENDIX G

PUBLICATIONS OF AMERICAN MARINE STANDARDS COMMITTEE[1]

(To August 1, 1928)

A. M. S. C. Serial No.	Title or Subject
	Organization of the American Marine Standards Committee, Its Constitution and Rules
	Stability and Loading of Ships (out of print)
1.	Glass for Air Ports and Fixed Light
2.	Mooring Bits—Cast Iron
3.	Fixed Lights for Ships
	Type A—Pressed Steel Frame
	Type B—Cast Brass Frame
	Type C—Cast Brass Finished Frame
4.	Rigging Screws for Ships
	Rigging Screws with Spliced Rope
	Rigging Screws with Sockets
5.	Ship Fittings for Decks and Rigging
	Chain Plates
	Wire Rope Sockets
	Solid Thimbles for Wire Rope
	Open Thimbles for Wire Rope
	Pad Eyes and Links
6.	Cargo Handling Gear for Ships
	Railroad Iron Sling
	Chain Sling
7.	Kinds and Sizes of Hose for Ship Equipment
8.	Specification for ¾″ and 2″ Flexible Metallic Hose
9.	Specification for 2½″ Double-Jacketed Cotton Rubber-Lined Fire Hose
10.	Specification for 2½″ Unlined Linen Fire Hose
11.	Instructions for Care and Maintenance of Steel Hulls
12.	General Instructions for Operation, Care and Upkeep of Scotch Type Marine Boilers
13.	Kinds and Sizes of Mattresses and Pillows and Woolen, Linen and Cotton Articles for Ship Equipment
14.	Kinds and Sizes of Glassware for Ship Equipment
15.	Kinds and Sizes of Silverware for Ship Equipment
16.	Distinctive Markings for Piping
17.	Specification for 2½″ Single-Jacketed Cotton Rubber-Lined Fire Hose
18.	Essential Machinery Spare Parts, Accessories and Supplies for Sea-going Ships
19.	Equipment and Methods for Safety on Ships
20.	General Instructions for Operation, Care and Upkeep of Water Tube Marine Boilers
21.	Condenser Tube Ferrules and Tube Sheets
22.	Specifications for Pressure and Vacuum Gauges for Ships

[1] U. S. Bureau of Standards, mimeographed, Washington, August 1, 1928.

A. M. S. C. Serial No.	Title or Subject
23.	Mooring Bitts—Cast Steel
24.	Fire Hose Racks for Ships
	Metal Rack—Pocket Type
	Metal Rack—Saddle Type
	Wooden Rack
25.	Pilot Ladder
26.	Tubular Steel Cargo Booms
	5 Tons Capacity
	10 Tons Capacity
	15 Tons Capacity
	20 Tons Capacity
	30 Tons Capacity
27.	Couplings for Propeller Shafting
	Flanged Couplings
	Loose Couplings for Inboard Shafts
28.	Propeller Shaft Details
	Tail Shafts and Stern Tube Bearings
	Propeller Keys
	Propeller Nuts
	Stern Tube Stuffing Boxes
29.	Ship Propeller Details
	Hubs for Built-up Propellers with Recessed Blades
	Fairwater Caps for Built-up Propellers with Recessed Blades
30.	Propeller Hub Studs, Nuts and Lock Screws
31.	Packing Gland for Propeller Hubs (optional method)
32.	Fire Clay Refractories for Marine Service
33.	Life Boat Sizes and Capacities
	Narrow Type
	Wide Type
34.	Marine Glue for Seams of Ship Docks—Specification
35.	Insulation of Piping and Machinery on Ships—General Specifications
36.	Magnesia Molded Pipe Covering and Blocks—Specification
37.	Magnesia Asbestos Plaster—Specification
38.	Asbestos Millboard—Specification
39.	Hair Felt for Insulation—Specification
40.	Cotton Duck for Insulation Coverings—Specification
41.	Metallic Packing for Condenser Tubes—Specification
42.	Ship Propeller Details
	Hubs for Built-up Propellers, with Flush Facings
	Fairwater Caps for Flush Faced Propeller Hubs
43.	Rubber Air Hose—Specification
44.	Rubber Steam Hose—Specification
45.	1½″ Water Hose, Rubber Covered—Specification
46.	2½″ Water Suction Hose, Smooth Bore—Specification
47.	Oil Suction and Discharge Hose, Rubber Covered—Specification
48.	Scupper Valves—Sizes 3″, 4″, 5″ and 6″
49.	Cargo Boom Fittings
	Boom Steps, Bracket Type, for 5, 10 and 15 Ton Booms
	Boom Steps, Deck Type, for 15, 20 and 30 Ton Booms
50.	Fittings for Tubular Steel Cargo Booms
	Heel Fittings for 5, 10, 15, 20 and 30 Ton Booms
	Caps of Double Pin Type for 5, 10, 15, 20 and 30 Ton Booms
	Caps of Single Pin Type for 5, 10, 15, 20 and 30 Ton Booms

APPENDIX H

FEDERAL SPECIFICATIONS USED IN THE BUREAU OF STANDARDS CERTIFICATION PLAN[1]

Specification No.	Commodities Covered
23	Large Tungsten Filament Incandescent Electric Lamps
26	White Floating Soap
27	Liquid Soap
28	Soap Powder
29	Salt Water Soap
30	Automobile Soap
31	Chip Soap
32	Ordinary Laundry Soap
33	Grit Cake Soap
34	Scouring Compounds for Floors and Soap Scouring Compound
35	Hand Grit Soap
36a	Fire Extinguishing Liquid (Carbon Tetrachloride Base)
37	Leather Belting (Vegetable Tanned)
52a	Wood Screws
55	Cutout Bases
57	Flexible Non-Metallic Tubing
58	Dry Cells (Being Revised)
62	Snap Switches
65	Rubber Covered Wires and Cables for Ordinary Purposes
80	Coal Tar Pitch for Roofing
81	Coal Tar Saturated Rag Felt for Roofing and Waterproofing
82	Surfacing Materials for Bituminous Built-up Roofing
83	Coal Tar Pitch for Waterproofing and Damp-proofing
84	Asphalt for Mineral Surfaced Roofing
85	Asphalt for Waterproofing and Damp-proofing
86	Asphalt Saturated Rag Felt for Roofing and Waterproofing
87	Asphalt Primer for Roofing and Waterproofing
88	Asphalt for Insurfaced Built-up Roofing
123	Flat Glass for Glazing Purposes
124	Hand Chemical Fire Extinguisher (One Quart Carbon Tetrachloride Type)
127a	25% Rag Blotting Paper, White and Colored
128a	Desk Blotting Paper, Colored
129a	Chart Paper
130a	Mimeograph Paper
131a	50% Rag Mimeograph Paper
132a	Wood Manila Wrapping Paper
133a	Rope Manila Wrapping Paper
175	Knife Switches
177a	Kraft Wrapping Paper
178a	Sulphite Manila Wrapping Paper
179	No. 1 Grade Blue-Print Paper (Sensitized and Unsensitized)
180	No. 2 Grade Blue-Print Paper (Sensitized and Unsensitized)
181	No. 3 Grade Blue-Print Paper (Sensitized and Unsensitized)
182a	Paper, Brown Process (Sensitized and Unsensitized)

[1] U. S. Bureau of Standards, mimeographed, Washington, Feb., 1928.

Specification No.	Commodities Covered
183	Upholstery Leather
184	Lace Leather (Vegetable Tanned)
191	Brush, Blacking Dauber
192	Brush, Casting
193	Brush, Clothes Scrubbing
194	Brush, Cuspidor
195a	Brush, Dauber, Long Paddle
196	Brush, Deck Scrubbing
197	Brush, Hand Floor Scrubbing
198	Brush, Hair, Military
199	Brush, Radiator Dusting
200	Brush, Shaving
201	Brush, Sidewalk
202	Brush, Tooth
203	Brush, Window
204	Broom, Rattan Push
205	Broom, Rattan (Upright)
206	Broom, Scrubbing
207	Broom, Wire Push
208a	Duster, Counter
213	Hand Chemical Fire Extinguisher (Soda and Acid Type)
214	Asphalt Prepared Roofing
241	Sole Leather (Vegetable Tanned)
242	Wrought Iron Pipe (Welded) (Black and Galvanized)
244	Milled Toilet Soap
245	Powdered Soap (For Laundry Use)
246	Liquid Soap (For Laundry Use)
275	Road Oil for Hot Application (Type OH–1–25)
276a	Asphalt for Use in Road and Pavement Construction
277	Petroleum Asphalt for Joint Fitter (Squeegee or Pouring Method) (Type PAF–1–25)
279	Tars for Cold Application
280	Refined Tar for Hot Application (Type TH–1–25)
281	Tar for Use in Repair Work
282	Refined Tar for Construction
287	Tubing, Copper, Seamless and Pipe, Copper, Seamless Standard Iron Pipe Size
291	Friction Tape
292	Rubber Insulating Tape
294	Asphalt-saturated Woven Cotton Fabric for Waterproofing
295	Asphalt-saturated Rag Felt for Flashings
296	Slate-surfaced, Asphalt-prepared Roofing and Shingles
297	Wire Rope
311	Rigid Conduit, Enameled
312	Rubber Gloves for Electrical Workers (For Use in Connection with Apparatus or Circuits Not Exceeding 3,000 Volts to Ground)
314	Railroad Track Scales
319	100% Rag Bond Paper, White
320	50% Rag Bond Paper, White and Colored
321	100% Rag Ledger Paper, White
322	75% Rag Ledger Paper, White and Colored
323	100% Rag Manifold Paper, White and Colored
324	Lithograph-finish Map Paper
325	50% Rag Lithograph-finish Map Paper
326	75% Rag Lithograph-finish Map Paper
327	Blotting Paper, White and Colored
328	Sulphite Bond Paper, White and Colored

Specification No.	Commodities Covered
329	Sulphite Writing Paper, White and Colored
330	100% Rag Heavy Ledger Paper, White
331a	50% Rag Manifold Paper, White and Colored
332	Brooms, Whisk
333a	Brooms, Corn
336	Builders' Hardware
342a	Pipe, Brass, Seamless, Iron Pipe Size, Standard and Extra Strong
343a	Cast Iron Soil Pipe and Fittings, Coated and Uncoated
347	Lap Welded and Seamless Steel Boiler Tubes
349	Lap Welded Charcoal Iron Boiler Tubes
362	Liquid Measuring Devices, Retail Type
363	Burglar Resisting Safes
380	Cement, Asphalt Plastic
394	General Specifications for Paper (Test Methods)
396	Brush, Calcimine
397	Brush, Dust, Ceiling and Wall
398	Brush, Fiber Garage
399a	Brush, Flat Fitch
400	Sweep, Floor, Hair
401a	Brush, Glue, Round
402	Brush, Glue, Flat
403	Brush, Lacquering, Flat Camel Hair
404	Brush, Marking
405	Brush, Mottling, Camel Hair
406a	Brush, Sash Tool, Oval
407	Brush, Hand Scrub, White Tampico
411	Tableware, Silver Plated
423	Roofing, Prepared, Asphalt and Asbestos, Slate-surfaced
424	Roof Coating, Asphalt Fibrous
425	Paper, Carbon, Black, Light Weight (For Typewriter Use)
426	Paper, Carbon, Black, Standard Weight (For Typewriter Use)
484a	Paper, Manifold, 50% Rag, White and Colored, Unglazed
511	Brooms, Metal Case
512	Brushes, Flowing, Badger Hair
513	Brushes, Flowing, Camel Hair
514	Brushes, Flowing, Fitch or Skunk Hair
515	Brushes, Paint, Flat Metal Bound, High Grade
516	Brushes, Paint, Flat Metal Bound, Medium Grade
517	Brushes, Radiator Bronzing
518	Brushes, Roof, Knotted Style, Three Knots
519	Brushes, Stencil (Flag Ends Cut)
520	Brushes, Stencil (Flag Ends Preserved)
521	Brushes, Varnish, Flat (High Grade)
522	Brushes, Varnish, Flat (Medium Grade)
523	Brushes, Wall Stippling
524	Brushes, Whitewash
525	Dusters, Painters,' Flat
526	Dusters, Painters,' Round

APPENDIX I

USE OF LABELS BY NATIONALLY RECOGNIZED ORGANIZATIONS[1]

Among the agencies that are engaged in activities relating to the formulation of specifications, or the establishment of quality standards, manufacturing in conformity therewith and taking steps to insure compliance therewith are the following that make use of labels or their equivalent for this purpose:

American Corn Millers' Federation has adopted a symbol to be licensed by the federation to all millers who will agree to conform to its specifications for corn meal.

American Gas Association has established a gas appliance testing laboratory and permits manufacturers of appliances approved by the laboratory as complying with the association's safety requirements to attach to the appliance the official approved seal of the association.

American Institute of Steel Construction (*Inc.*) permits its members who adhere to its code of standard practice to use the institute's symbol as a label for their commodities.

American Petroleum Institute grants to manufacturers the right to place its official monogram on certain standardized equipment upon certifying that the material so marked complies with the Institute's specifications.

American Society of Mechanical Engineers permits manufacturers to place the A. S. M. E. symbol on a boiler complying with the requirements and tests of its boiler construction code.

Arkansas Soft Pine Bureau permits member mills to use the registered symbol of the association with stock grade marked in accordance with American Lumber Standards.

Associated Factory Mutual Fire Insurance Companies permits manufacturing firms to use the association's identification mark of approval on devices specifically approved by the association as to both design and construction.

Associated General Contractors of America enters into agreement with manufacturers in accordance with which concrete mixers complying with A. G. C. standards carry the name plate indicating this fact.

Associated Tile Manufacturers has adopted a color scheme for grade marking and issuing certificates to accompany packages of white glazed tile and unglazed ceramic mosaic manufactured to comply with the simplified practice recommendation relating to this group of commodities.

Better Bedding Alliance of America was organized chiefly to encourage the truthful labeling of the filling contents of bedding and the discouragement of any misrepresentation of the product.

[1] National Bureau of Standards, mimeographed, Washington, 1928.

Canners League of California secured the adoption of a law requiring all canned peaches, pears, apricots, and cherries of a grade below certain approved standards to be marked with the word "seconds" embossed on the top of the can.

Commission on Standardization of Biological Stains issues certificates in the form of labels to be attached to bottles containing stains submitted to it and found to comply with its specifications.

Concrete Products Association issues certificates of quality to its members when it is found that their products meet the requirements of the American Concrete Institute standards.

Glycerine Producers' Association permits members that follow the association's formula in manufacturing radiator glycerine to use the association's seal as a label to indicate the quality of their radiator glycerine.

Heating and Piping Contractors' National Association has adopted a national insignia and certificate and also a boiler plate for the identification of heating plants complying with its specifications.

Interstate Cotton Seed Crushers' Association dismisses from membership any of its members found guilty of misbranding or adulteration.

Malleable Iron Research Institute issues to manufacturers of products conforming to its specifications certificates which permit them to use the trade-mark of the Institute in advertising their products.

Maple Flooring Manufacturers' Association permits member firms to use the association's trade-mark on maple, beech or birch flooring guaranteed by the association to comply with its grades and standards.

National Association of Finishers of Cotton Fabric licenses its members to use the association's label showing that goods to which it is applied comply with the association's requirements for fastness to light and washing.

National Retail Lumber Dealers Association permits its member companies to issue to purchasers certificates, underwritten by the association, guaranteeing that the material delivered conforms in grading with nationally adopted manufacturer's standards, and in quantity exactly with the invoice rendered.

Northern Hemlock and Hardwood Manufacturers Association has adopted a system of branding and grade marking whereby a member firm is assigned an identifying number and is licensed to use the association's brand to show that its lumber is graded in accordance with American Lumber Standards.

Paperboard Industries Association grants to its members the privilege of using its insignia in connection with the certificates used by manufacturers showing that boxes bearing these certificates conform to all construction requirements of the Consolidated Freight or the Official Express Classification.

Periodicals, such as Good Housekeeping Magazine, Modern Priscilla, and Popular Science Monthly, have set up specifications for various lines of commodities and issue the equivalent of certificates of approval in the form of labels for trade-brand articles meeting these specifications.

Pipe Nipple Standards Corporation (not a manufacturing firm but made

up of representatives of manufacturers) licenses manufacturers to use its registered trade-mark stamped on goods to identify pipe nipples manufactured to comply with its standards.

Porcelain Plumbing Fixture Manufacturers (advisory committee to the Bureau of Standards) issues labels certifying compliance with the commercial standards for porcelain plumbing fixtures.

Society for Electrical Development has inaugurated a so-called "red-seal plan" for identifying a house that is properly and adequately wired in accordance with approved specifications.

Southern Pine Association employs a staff of inspectors to visit the plants of its member firms who are permitted to place the mark of the grader on all lumber they make.

Steamboat Inspection Service of the Department of Commerce permits manufacturers to identify by labels, or advertising, devices built to comply with its requirements.

Tissue Paper Manufacturers' Association authorizes its members to use the official label and seal of the association in guaranteeing packages of tissue paper to be in accordance with the simplified practice recommendation for this commodity.

Underwriters' Laboratories, maintained by the National Board of Fire Underwriters, have prepared definite specifications relating to design details and performance characteristics of certain appliances and devices and licenses manufacturers receiving the required inspection and testing service to identify goods meeting its specifications by means of stamps, labels, or other markings.

Vitreous China Plumbing Fixtures Manufacturers (advisory committee to the Bureau of Standards) authorizes manufacturers to employ labels for grade marking products complying with the simplified practice recommendations for this group of commodities.

APPENDIX J

ADVANTAGES OF STANDARDIZATION REPORTED BY THE DETROIT EDISON COMPANY[1]

Standardization of Packing

(1) *Requisitioning Department* (Construction, Operating, Underground, Electrical, etc.).

- (a) The *correct* packing for a given service specifically covered, preventing the evils attendant in ordering the wrong material.
- (b) Standard descriptions enable subordinates to order material thereby sparing plant executives from routine work.
- (c) The packing selected is based on a decision of all the plant engineers, eliminating the personal element.
- (d) The danger of drawing on shelf worn and stale packings eliminated owing to rapid turnover of a few brands.
- (e) Because of the reduced variety of brands, smaller stocks and quicker turnovers are effected.

(2) *Purchasing Department*

- (a) Requisitions received uniformly written, there being no question of what is wanted.
- (b) Having eliminated a large number of miscellaneous brands, the remaining are ordered in larger quantities, thereby permitting "quantity purchase" savings.

Our annual purchases of packing are, roughly, $5,000. Standardization will enable us to make a saving of between $800 and $1,000.

(3) *Stores Department*

- (a) Fewer orders
- (b) Fewer items
- (c) Less bookkeeping
- (d) Less handling
- (e) Reduced stocks
- (f) Faster turnover
- (g) Practical elimination of obsolete packing.

Conclusions

The standardization of packings brings to the user the correct material, in a fresh condition, with a minimum expenditure of energy and loss of time and at the lowest price.

[1] From material supplied by courtesy Detroit Edison Company, 1928.

Standardization of Firebrick

(1) *Design*

(a) Simplification of design: Fewer shapes to consider—hence more rapid progress on the board.
(b) Simple designs are notoriously the strongest.
(c) Requires less experienced designers when standard construction is pursued and hence reduction in expensive help.
(d) Less danger of error.
(e) Changes can be more readily effected.
(f) When necessary, jobs may be rushed through without danger.
(g) Checking of drawings becomes matter of routine rather than a feat.
(h) Fewer drawings—hence lower drawing costs, fewer draftsmen and less materials.
(i) Changes permissible without danger of shapes becoming obsolete.

(2) *Construction*

(a) Simpler construction—hence more rapid progress in field and less intelligent help necessary.
(b) Standardization of design permits transfer from one job to another without undue experience necessary to carry on.
(c) Stronger construction—hence less maintenance and outage, with attendant reduction in operating costs.
(d) Less material and fewer brickmasons required.
(e) Danger of holding up of job, resulting from shortage of material, reduced.
(f) Reduction in operating records.

(3) *Purchasing Department*

(a) Fewer orders.
(b) More carload shipments and hence savings in freight.
(c) Material obtainable from stock, permitting quick shipments.
(d) Fewer special shapes eliminate special high-priced molds, special firing and expensive material. Also, special shapes often turn out unsatisfactorily, delaying all departments.
(e) Orders simplified.
(f) Standard shapes, for a given weight, cost about ⅓ that of special shapes.

(4) *Stores Department*

(a) Stocks reduced at plants and warehouses.
(b) Any overstocking in one locality can be adjusted promptly. This is hindered by special shapes.
(c) Turnover improved.
(d) Negligible scrapping of obsolete shapes and attendant losses.

(5) *Vendors*
- (a) Vendor is able to meet the demands of the customer promptly and completely.
- (b) Receives fewer complaints.
- (c) Leaves the customer satisfied because customer gets low price, car-lot shipments, and uniform product, *promptly.*

Conclusions

The standardization of the firebrick has resulted in eliminating practically 65% of the number of shapes of brick formerly purchased. It is too early to show savings due to quantity purchases, because of our present effort to reduce the large stocks. We believe that in some ways stronger construction has been made possible by the studying of details. The reduction of stocks, more frequent turnovers, fewer orders, car-lot shipments, etc., are factors that have more than justified the work put in on standardization of this item.

Standardization of Piping

(1) *Requisitioning Department*
- (a) Terminology—The correct descriptions furnished enable the requisitioning departments to specify material so that:
  - (1) Correct material will be ordered.
  - (2) There will be no delay while buyer finds out the meaning of ambiguous descriptions.
  - (3) Many telephone calls eliminated.
- (b) Material—Savings that are effected through selection of "best" valve for each type of duty:
  - (1) Reduced maintenance charges.
  - (2) Uniformity of equipment in plant.
  - (3) Fewer replacement parts required.
  - (4) Lower unit costs due to concentrated purchase or larger quantities.

(2) *Stores Department*
- (a) Terminology—Uniformity in descriptions of identical materials will:
  - (1) Result in proper identification for posting, pass-out records, and checking with standard and surplus stock.
  - (2) Eliminate duplicate stock numbers for identical materials.
  - (3) Make possible the requisitioning of material by persons not familiar with the material itself.
  - (4) Eliminate many returns of material incorrectly ordered through inadequate descriptions.
- (b) Material—Standardization will:
  - (1) Eliminate items where several valves are used for the same purpose.
  - (2) Reduce the number of different parts required for repairs to various makes of valves.

(3) *Purchasing Department*

(a) Terminology—Uniformity will result in:

(1) Fewer telephone calls to determine what material is wanted.

(2) Much time saved which has been required for rewriting requisitions.

(3) Positive identification of material in purchase records.

(4) More rapid handling of orders all through Department because of complete, concise and uniform descriptions.

(b) Material—Standardization of valves permits greater concentration of purchases, which in turn, means fewer orders and lower prices.

Other Standardization Work

Sub-Committee No. 10—Stokers:

The principal saving that will be realized by decisions reached to date is by adoption of the two-piece tuyere. When this substitution is complete, we will replace in one year (using figures for 1926):

17,614 tuyere noses @ $.603 ea. avg.	$10,600.00
Instead of	
17,614 tuyeres @ $1.35 ea. avg.	23,715.00
Yearly saving on this part alone	$13,115.00

Item No. 2—Committee No. 7—Carbon Brushes:

This Committee has standardized all brushes that are carried in stock, reducing the total number of items in stock by approximately 25%. The Stores Department has been given the scale of discounts in order that in all cases the most economical quantity may be ordered. These two facts have assisted us in buying all our carbon brushes at from 10% to 20% under previous levels. This means a saving of approximately $3,000.

Because of the large number of brushes that were discontinued and will have to be used up, the Committee has not yet attempted to go over the non-stock items. There are as many of these as there were stock-items, and if anything we should produce better results in this group.

Item No. 6—Sub-committee No. 12—Brooms, Brushes, Dusters, etc:

We have been able to cut down the types of the following items:

Brooms	13 to 6
Dusters	6 to 3
Marking brushes	6 to 1
Kalsomine brushes	5 to 1
Paint brushes	11 to 3
Sash tools	7 to 1
Varnish brushes	26 to 5

Such a reduction in types will make a considerable saving in the purchase of these items. However, at this time, we are unable to give an estimate of this saving in dollars and cents.

APPENDIX K

EXPENDITURES FOR STANDARDIZATION BY TECHNICAL SOCIETIES, TRADE ASSOCIATIONS, STATE AND FEDERAL GOVERNMENTS IN 1926[1]

In an effort to determine the amount of money expended annually on standardization by technical societies, trade associations, and state and federal governments, a letter was prepared in which the following three questions were asked:

(1) Approximately how much was spent by your organization in 1926 for Standardization, including such items as Executive Salaries, Office Expenses, Conducting Conferences, Publication, Research, Travel, etc.?

(2) How much did your organization contribute to the work of other standardization agencies in 1926, in addition to the foregoing?

(3) What would be your estimate of the amount expended by industrial companies and persons participating in your work in 1926, for salaries and traveling expenses not included in your budget for standardization?

Number of inquiries sent out	353
Number of replies received	243
Number reporting expenditures and stating amounts	91
Number reporting expenditures but giving no amounts	31
Number of inquiries unanswered	110
Percentage of replies received	69

The same letter was sent to the secretary of the several states.

Number of inquiries sent out	43
Number of replies received	29
Number reporting expenditures and stating amounts	4
Number reporting expenditures but giving no amounts	10
Number of inquiries unanswered	19
Percentage of replies received	60

The results of the survey are shown in the following table:

Group	Question I	Question II	Question III	Total
Trade Associations	$2,222,306.17	$34,298.00	$735,411.37	$2,992,015.54
Technical Societies	387,140.06	28,760.50	414,600.00	830,500.56
State Governments	134,240.00	..	..	134,240.00
Federal Government	4,250,500.00	..	..	4,250,500.00
Total	$6,994,186.23	$63,058.50	$1,150,011.37	$8,207,256.10

[1] U. S. Department of Commerce, unpublished.

Trade Associations Reporting Expenditures for Standardization in 1926

American Electric Railway Association
American Foundrymen's Association
American Gas Association
American Institute of Steel Construction
American Malleable Castings Association
American Paper and Pulp Association
American Petroleum Institute
American Railway Association (including all divisions of the A. R. A.)
American Zinc Institute
Asphalt Association
Associated Factory Mutual Fire Insurance Companies
Associated General Contractors of America
Associated Knit Underwear Manufacturers of America
Association of American Steel Manufacturers
Association of Electragists, International
Association of Feed Control Officials of the United States
Association of Scientific Apparatus Makers of the United States of America
Automotive Electric Association
Bureau of Explosives
California Redwood Association
Canners League of America
Compressed Gas Manufacturers' Association
Concrete Reinforcing Steel Institute
Cover Paper Manufacturers' Association
Drill and Reamer Society, The
Glass Container Association
Gypsum Industries (now The Gypsum Institute)
Institute of American Meat Packers
International Association of Electrotypers of America
International Association of Milk Dealers
Interstate Cotton Seed Crushers' Association
Jute Twine Manufacturers' Association
Laundryowners' National Association
Machinery Builders' Society
Manufacturing Chemists' Association of the United States
Maple Flooring Manufacturers' Association
Milling Cutter Society
National Association of Cost Accountants
National Association of Dyers and Cleaners
National Association of Farm Equipment Manufacturers
National Association of Marble Dealers
National Association of Purchasing Agents
National Association of Wood Turners
National Building Granite Quarries Association
National Bureau of Casualty and Surety Underwriters

National Committee on Metals Utilization
National Electric Light Association
National Fertilizer Association
National Hardwood Lumber Association
National Lumber Manufacturers' Association
National Machine Tool Builders' Association
National Paving Brick Manufacturers' Association
National Sand and Gravel Association
National Terra Cotta Society
National Veneer and Panel Association
National Wholesale Grocers' Association of the United States
Natural Gas Association of America
New England Water Works Association
North Carolina Pine Association, The
Paperboard Industries Association
Portland Cement Association
Sand-Lime Brick Association
Silk Association of America, The
Southern Pine Association
Southern Sash, Door and Millwork Manufacturers' Association
Steel Founders' Society of America
Tap and Die Institute, The
Tissue Paper Manufacturers' Association
Writing Paper Manufacturers' Association

TECHNICAL SOCIETIES REPORTING EXPENDITURES FOR STANDARDIZATION DURING 1926

American Chemical Society
American Institute of Architects
American Institute of Electrical Engineers
American Institute of Mining and Metallurgical Engineers
American Public Health Association
American Railway Engineering Association
American Society for Municipal Improvements
American Society for Steel Treating
American Society for Testing Materials
American Society of Agricultural Engineers
American Society of Civil Engineers
American Society of Heating and Ventilating Engineers
American Society of Mechanical Engineers
American Standards Association
Central Committee on Lumber Standards
Electrical Safety Conference
Illuminating Engineering Society
Institute of Paint and Varnish Research
National Board of Fire Underwriters
National Fire Protection Association

National Safety Council
Society of Automotive Engineers
Underwriters' Laboratories

ASSOCIATIONS AND SOCIETIES REPORTING PARTICIPATION IN STANDARDIZATION, THE EXPENSES OF WHICH ARE BORNE BY THE MEMBERS

American Association of Woolen and Worsted Manufacturers
American Bankers' Association
American Paint and Varnish Manufacturers' Association
American Specification Institute
American Steel and Heavy Hardware Association
American Vitrified China Manufacturers' Association
American Waxed Paper Association
American Wood Preservers' Association
Association of Governmental Labor Officials of the United States and Canada
Association of Iron and Steel Electrical Engineers
National Association of Woolen and Worsted Spinners
National Canners' Association
National Electrical Manufacturers' Association
National Varnish Manufacturers' Association
Paint Manufacturers' Association of the United States
Refrigerating Machinery Association
United Typothetæ of America

ASSOCIATIONS AND SOCIETIES REPORTING NO EXPENDITURES FOR STANDARDIZATION IN 1926

American Association for the Advancement of Science
American Automobile Association
American Boiler Manufacturers' Association
American Bottlers of Carbonated Beverages
American Bureau of Shipping
American Dental Trades Association
American Envelope Manufacturers' Association
American Hotel Association of the United States and Canada
American Institute of Chemical Engineers
American Institute of Consulting Engineers
American Institute of Marine Underwriters
American Iron and Steel Institute
American Management Association
American National Retail Jewelers' Association
American Short Line Railroad Association
American Walnut Manufacturers' Association
Armco Culvert and Flume Manufacturers' Association
Artistic Lighting Equipment Association
Asbestos Paper Manufacturers' Association

Asphalt Shingle and Roofing Association
Associated Leather Goods Manufacturers of the United States of America
Associated Metal Lath Manufacturers
Associated Office Furniture Manufacturers
Association of Dairy, Food and Drug Officials of the United States
Association of Manufacturers of Wood Working Machinery
Association of Wilton and Brussels Manufacturers of America
Automotive Equipment Association
Automotive Wood Wheel Manufacturers' Association
Building Owners' and Managers' Association of San Francisco
Bureau of Envelope Manufacturers of America
Bureau of Railway Economics
Cigar Manufacturers' Association of America
Common Brick Manufacturers' Association of America
Concrete Products Association
Copper and Brass Research Association
Cotton Thread Manufacturers' Association
Eastern Clay Products Association
Edible Gelatin Manufacturers' Research Society of America
Electric Hoist Manufacturers' Association
Elevator Manufacturers' Association of the United States
Foundry Equipment Manufacturers' Association
Glazed and Fancy Paper Manufacturers' Association
Grain Dealers' National Association
Grey Iron Founders' Association
Hardwood Manufacturers' Institute
Hollow Metal Door Society
International Apple Shippers' Association
International Association of Casualty and Surety Underwriters
International Association of Industrial Accident Boards and Commissions
International Railway Fuel Association
Latch Needle Manufacturers of the United States
Leather Belting Exchange
Metal Bed and Spring Bed Institute
Motor Cycle and Allied Trades Association
National Association of Amusement Parks
National Association of Fan Manufacturers
National Association of Glue Manufacturers
National Association of Ice Cream Manufacturers
National Association of Lighting Equipment Dealers
National Association of Manufacturers of Heating and Cooking Appliances
National Association of Manufacturers of Pressed and Blown Glassware
National Association of Steam Specialty Manufacturers
National Association of Steel Furniture Manufacturers
National Association of Waste Material Dealers
National Association of Wool Fiber Manufacturers
National Boiler and Radiator Manufacturers' Association
National Federation of Construction Industries (dissolved)

National Federation of Implement Dealers' Association
National Founders' Association
National Hay Association
National Industrial Conference Board
National Lime Association
National Paint, Oil and Varnish Association
National Paper Box Manufacturers' Association
National Petroleum Association
National Piano Manufacturers' Association of America
National Pipe and Supplies Association
National Restaurant Association
National Warm Air Heating and Ventilating Association
Optical Manufacturers' Association (dissolved)
Optical Society of America
Plumbago Crucible Association
Plywood Manufacturers' Association
Power Transmission Association
Road Machinery Manufacturers' Association
Society of American Foresters, The
Society of Gas Lighting

Associations and Societies Unable to Estimate Expenditures for Standardization in 1926

American Bureau of Welding
American Concrete Institute
American Corn Millers' Federation
American Fruit and Vegetable Shippers' Association
American Institute of Baking
Asbestos Brake Lining Association
Associated Cooperage Industries of America
Association of Edison Illuminating Companies
Association of Master Plumbers
Association of Official Agricultural Chemists
Atlantic Coast Shipbuilders' Association
Heating and Piping Contractors' National Association
National Aeronautic Association of the United States of America
National Association of Brass Manufacturers
National Association of Building Owners and Managers
National Association of Cotton Manufacturers
National Association of Mutual Casualty Companies
National Association of Sheet and Tin Plate Manufacturers
National Association of Wool Manufacturers
National Automatic Sprinkler Association
National Research Council
National Retail Dry Goods Association
National Retail Hardware Association
Rice Millers' Association

Rubber Heel Club of America, The
Society of Gas Lighting
Steel Barrel Manufacturers' Institute
Sterling Silversmiths Guild of America
Structural Service Bureau
Technical Association of the Pulp and Paper Industry
Telephone Group